

**UNIVERSITY OF MINNESOTA  
SEA GRANT COLLEGE PROGRAM**

**STRATEGIC PLAN 2014–2017**



*“Superior Science for You”*

## ***MINNESOTA IN CONTEXT***

Minnesota Sea Grant has offices near the port of Duluth-Superior. Even though this port lies 1,500 miles from the open ocean and operates only nine months out of the year, it is one of the most active by tonnage in the United States. The port spans the Minnesota-Wisconsin state boundary and opens into Lake Superior, a body of water that is so expansive it holds 10% of the Earth's fresh surface water and qualifies as an inland sea.

Lake Superior modifies weather, develops rip currents, supports fishing and maritime industries, and has held the attention and support of the National Oceanic and Atmospheric Administration (NOAA) Sea Grant Program for over 35 years. One-hundred-ninety miles of Lake Superior coastline warrants a Sea Grant program in Minnesota, but Lake Superior is not the states, nor Minnesota Sea Grant's, only conduit to the open ocean.

The Mississippi River trickles out of Lake Itasca near the middle of Minnesota. By the time it bisects the state's Minneapolis/St. Paul population center; it is large enough to float barges. It inspired the flour dynasties of Pillsbury and General Mills and the fortunes of other businesses reliant on hydropower and waterborne transportation. By the time it touches salt water, the river is carrying a potent nutrient load that contributes to the anoxic "dead zone" in the Gulf of Mexico. Some of these nutrients can be traced back 2,300 miles to Minnesota farming practices.

In Minnesota, Lake Superior and the Mississippi River must share the limelight with the state's plethora of lakes (Minnesota license plates carry a "10,000 lakes" motto, but there are at least 1,500 more). For every \$2 that NOAA allocates for Minnesota Sea Grant, the state provides \$1 with the expectation that the program's reach will include all of the state's aquatic resources. So, although Minnesota Sea Grant focuses much of its research and outreach on Lake Superior, notable effort is also spent on aquatic challenges elsewhere in the state.

### **Lake Superior**

A product of volcanic fury and glacial scouring, Lake Superior is a 10,000-year-old puddle compared to some of the ancient lakes that covered parts of North America's Upper Midwest. Still, it's a whopper of a puddle, the largest potable lake by surface area in the world. Lake Superior contains over half of the water in the Laurentian Great Lakes, a quantity that translates into three quadrillion ( $3 \times 10^{15}$ ) gallons. For the last century, people in thirstier areas of the country, and the globe, have made various (and so far unsuccessful) attempts to claim some of this water for their own.

Humans began visiting the watershed as the last glacier retreated over 7,000 years ago. Four thousand years later, people of the Woodland Culture settled along Superior's shores. They were replaced by the Dakota, who were in turn replaced by Ojibwa tribes. Historians believe French explorers touched Lake Superior in 1623. Britain claimed the area in 1783 but lost most of it to the newly formed United States of America 20 years later, at the end of the Revolutionary War. The U.S. and Canada share the lake and its

basin, which they govern in coordination with Minnesota, Wisconsin, Michigan, Ontario, and First Nation and Native American Ojibwa. Of the roughly 670,000 people living within the Lake Superior watershed, most reside along western shores in Duluth, Minnesota; Superior, Wisconsin; and Thunder Bay, Ontario.

Despite the lake's size, Lake Superior's watershed is relatively small, spanning 491,300 predominantly forested square miles. The coastal communities around Lake Superior are historically dependant on resource extraction (timber, iron, fisheries) and transportation (shipping, railroad), and more recently on tourism. The economic outlook for Minnesota's Lake Superior region is promising, despite less rosy predictions being made for most of the U.S. The tonnage moved through the Duluth-Superior Harbor has increased since 2005, and its value has soared; in two years, the price of iron-producing rock (taconite) doubled, and grain prices almost tripled. Iron Range expansion and construction projects mean that taconite, a major export of the region, will be an even bigger facet of northern Minnesota's economy over the next decade.

High-value wind generator components are passing through the port with increasing frequency. Also, commercial and recreational fisheries generate over \$100 million of economic activity around Lake Superior. The region attracts about 10% of Minnesota's tourist traffic, which translates into over one billion dollars-worth of spending along Minnesota's North Shore. Economic indicators suggest this figure will continue to grow.

Lake Superior's communities face challenges common to coastal communities elsewhere; however, their ecological bent and modest size make them a litmus test for integrating concepts such as conservation design, green ports, and aquatic invasive species education into society. Keeping Lake Superior clean is important since waterborne contaminants flowing from Lake Superior contribute to the pollution levels in the other Great Lakes. In fact, the International Joint Commission's zero-discharge program for nine persistent toxic substances in the Great Lakes is being piloted on Lake Superior for this and other reasons.

Jokingly called a "distilled-water ice bath," Lake Superior is clear, cold, and viewed as a model for fisheries restoration, contaminant research, and climate change monitoring. The Lake Superior Basin has a relatively simple ecosystem and is comparatively free from urban development. As such, it serves not only as the headwaters of the Great Lakes but also as a benchmark for understanding and evaluating the rest of the system. Lake Superior is playing an important role as a testing ground for interdisciplinary research and the application of science to policy to management decisions.

### **Across the State**

Minnesota's thousands of lakes range across three biomes: prairie grassland, coniferous forest, and deciduous forest. The lakes' surroundings range from wilderness to urbanized, and their clarity from see-through to algal soup. The number and variability of Minnesota lakes makes research comparisons meaningful, particularly for questions about the methylation of mercury, climate change, and water quality. Their number also helps

make Minnesota's aquaculture industry possible. The industry produces over three million pounds of food, sport, and baitfish each year.

Inland aquatic areas of national and international interest include the lakes of Voyager's National Park and the Boundary Waters Canoe Area Wilderness. Also, aside from the Mississippi, Minnesota encompasses all or part of the headwaters of major North American rivers, including the Minnesota, Red, St. Croix, St. Louis, and Rainy.

Minnesota is a paragon of environmental progress compared to many other states, especially because of its air and water quality achievements. Most Minnesotans (60%) live in the Twin Cities metropolitan area of Minneapolis/St. Paul, which is lauded as one of the most literate urban areas in the U.S. Historically, Minnesotans turn to the outdoors for recreational activities and continue to hold a progressive environmental ethic. With over 828,000 registered watercrafts, Minnesota ranks the fourth "boatiest" state in the nation, despite ranking twenty-first in population. About 19% of state residents fish, and over 28.6 million people visit Minnesota each year, of which about a third purchase fishing licenses.

As an example of the way Minnesota invests in its aquatic resources, the state and its partners have worked with recreational boaters and anglers, and aquaculture facilities, encouraging them to act in ways that will prevent the spread of aquatic invasive species.

### **Sea Grant in Minnesota**

As evidenced in the heart of this strategic planning document, Minnesota Sea Grant expects to capitalize on a blend of momentum and agility. By embracing tested methodologies and emerging opportunities, we will continue to construct a sturdy framework for sustaining coastal ecosystems and economies.

We are dedicated to providing scientific support for Minnesota's aquatic resources and their related economies. We partner with universities, federal and state agencies, the public, nonprofits, and industry to understand the complexity of environmental challenges such as sustainability, pollution control, and climate change. We then endeavor to help create innovative ways to confront such challenges.

Seeking a deeper understanding of environmental systems and societal potential for adapting to new information and new conditions in the Great Lakes, we are breaking ground in areas that include genetic engineering, persistent environmental toxins, endocrine-disrupting compounds in wastewater, and pheromone control of invasive fish. Using environmental psychology, social marketing, and business expertise, we continue to push science-based information into mainstream planning, particularly in port and other coastal community initiatives.

Athelstan Spilhaus, former dean of the University of Minnesota's Institute of Technology, initiated the idea for Sea Grant in the early 1960's. We are proud of this legacy and continue to build on his pioneering vision through the education, research, and outreach strengths of Minnesota's universities. Our transfer of Great Lakes information to

inland waters has demonstrated the responsiveness and relevance of Sea Grant to many non-Sea Grant states. Additionally, our collaborations within the Great Lakes Sea Grant Network and beyond have been recognized as extensive and important; one indication of this is our staff, researchers, and graduate students, have **earned over 50 awards** since 2005, including a Society for Conservation Biology Distinguished Service Award (2008) and the first-ever National Outstanding Invasive Species Outreach and Education Award (2012).

### ***THE ESSENCE OF SEA GRANT***

Sea Grant was created over 45 years ago to unite the academic power of the nation's universities with diverse groups from the public and private sectors. Leveraging broad partnerships, Sea Grant provides integrated research, outreach, and education programs aimed at creating tangible benefits for ocean and coastal environments and communities. As a division of NOAA, Sea Grant engages the resources of governments, universities, and citizens living and working in America's coastal and Great Lakes states to respond to problems and opportunities in these complex and dynamic environments.

Sea Grant is a network comprised of the National Sea Grant Office (NSGO), 33 university-based state programs, the National Advisory Board, a National Law Center, a National Sea Grant Library, and hundreds of participating institutions. This network enables NOAA and the nation to harness the best science, technology, and human expertise to balance human and environmental needs in coastal communities and in the oceans. Sea Grant's alliance with major research universities provides access to more than 3,000 scientists, outreach specialists, educators, and students. Sea Grant's university-based programs are important incubators for developing the scientists and managers needed to conduct research and to guide the responsible use and conservation of coastal and ocean resources in the future. With its strong research capabilities, local knowledge, and on-the-ground workforce, Sea Grant offers NOAA and the nation an unmatched ability to identify and capitalize on opportunities and generate practical solutions to real problems in real places.

### ***NATIONAL SEA GRANT COLLEGE PROGRAM'S VISION AND MISSION***

*The National Sea Grant College Program envisions a future where people live along our coasts in harmony with the natural resources that attracted and sustain them. This is a vision of coastal America where we use our natural resources in ways that capture the economic and recreational benefits they offer, while preserving their quality and abundance for future generations.*

This vision complements the vision articulated in NOAA's Strategic Plan: "Healthy ecosystems, communities and economies that are resilient in the face of change."

*Sea Grant's mission is to provide integrated research, communication, education, extension and legal programs that lead to the responsible use of the nation's ocean,*

*coastal and Great Lakes resources through informed personal, policy and management decisions.*

## **NATIONAL SEA GRANT CORE VALUES**

Since its inception, a strong set of core values has provided the foundation for Sea Grant's work. Sea Grant is founded on a belief in the critical importance of university-based research and constituent engagement. Sea Grant invests significantly in merit-reviewed research each year. Research discoveries are then distributed through Sea Grant's engagement programs. Meaningful and sustained engagement has allowed Sea Grant to form strong partnerships with leading coastal state research universities, with other NOAA programs, and with a wide range of public and private partners at federal, state and local levels. This has proven to be a highly effective way to identify and solve the most relevant problems facing coastal communities.

Moreover, Sea Grant's unique integration of research with engagement programs is at the heart of its mission. As a pioneer in translational research (from discovery to application), Sea Grant ensures that unbiased, science-based information is accessible to all. The diverse capabilities of Sea Grant's personnel enable the organization to be creative and responsive in generating policy-relevant research and disseminating scientific and technological discoveries to a wide range of audiences. Sea Grant's science-based, non-regulatory approach and its long-term history of engagement with local communities has made Sea Grant a trusted source of information. Sea Grant serves as a catalyst for decision support by increasing knowledge among decision-makers and the public as a whole. Sea Grant's commitment to these core values is vital to achieving the goals set forth in this plan.

## **MINNESOTA SEA GRANT'S VISION AND MISSION**

The Minnesota Sea Grant College Program's vision and mission statements encapsulate regionally important aspects of both NOAA's and the National Sea Grant College Program's statements. Rewritten and edited during the past year with the assistance of the Minnesota Sea Grant's staff and advisory committee, Minnesota Sea Grant's vision and mission statements are as follows:

*The Minnesota Sea Grant College Program envisions a future where its citizens use a science-based understanding of the environment to address issues concerning Lake Superior and Minnesota's aquatic resources and associated economies.*

*Minnesota Sea Grant's mission is to facilitate interaction among the public and scientists to enhance communities, the environment, and economies along Lake Superior and Minnesota's inland waters by identifying information needs, fostering research, and communicating results. More succinctly stated – Superior Science for You.*

By streamlining our vision and mission statements we more clearly relate our intentions, goals, and objectives to the larger public of Minnesota. These statements serve as the cornerstone of the strategic plan presented here.

We take our state and national mandates seriously, focusing on Minnesota's inland aquatic resources as well as on Lake Superior. We look to Lake Superior research and outreach needs as our primary program guidance, but actively pursue opportunities to apply our findings and programs to inland aquatic resource issues as well. Many of our outreach and research results have national and international implications. For example, we have extended outreach programs on invasive species to states along the Mississippi River and in the West. Web sites we created have garnered large national and international audiences. In addition, our biotechnology, aquaculture, water quality and recreation/tourism programs have resonated with inland as well as Great Lakes audiences, receiving multi-state, national and international attention. We take care not to duplicate what other agencies do, particularly with regard to inland waters.

Environmental and economic sustainability are often perceived as potentially conflicting goals. Specialists working in isolation from one another often fail to understand the links between human and natural resources. This lack of integration among various disciplines to solve problems results in inadequate ecosystem stewardship. A goal of the Minnesota Sea Grant program is to encourage multidisciplinary, integrated solutions that incorporate science with economic, societal, and political concerns.

### **External Factors**

To function within the unique historical, economic, and environmental characteristics of Minnesota, it is necessary to acknowledge factors external to our program that help direct our strategic plan. These include:

1. Conflicts between environmental and economic sustainability
2. Lack of understanding of the links between human and natural resources
3. Challenges in integrating disciplines to solve problems
4. A need to catalyze partnerships, awareness, and cooperation among organizations to improve ecosystem stewardship
5. Lack of application of the best technology to solve problems

### **Internal Factors**

Additionally, our program has Minnesota-specific internal factors that should be acknowledged as giving direction to our strategic plan. These include:

1. State and Federal mandates
2. A priority to address Lake Superior issues
3. Inland water resource issues that require attention
4. The national and international expertise of our staff
5. A need to avoid duplication of effort, especially for inland waters
6. Financial constraints due to budget allocation
7. A capacity to address quickly emerging and immediate response issues

## **Values**

Lastly, Minnesota Sea Grant has values that inspire the program's achievements. These values include commitments to:

1. Collaborations with partners to build community cooperation
2. A commitment to use multi-disciplinary approaches
3. Encouragement to use science in decision making
4. A responsiveness to inquiries with timeliness, conciseness, and accuracy
5. Generate results that are meaningful to the public
6. Incorporate social science methods to evaluate behaviors and attitudes
7. Encourage environmental stewardship
8. Pursue opportunities to increase environmental awareness and sustainability

## ***THE MINNESOTA SEA GRANT PROGRAM – A DESCRIPTION***

### **Administration**

Our administrative program works to maintain and enhance our Sea Grant program and further the goals of sustainable coastal communities by encouraging innovative research, outreach, and education programs. We do this through quality programmatic and administrative leadership, integrated programming, rigorous peer review of research proposals, strong links among Sea Grant, government, non-government and industry professionals, and a quality advisory process to guide our program direction and development.

### **Disciplines**

There are two major disciplines within Minnesota Sea Grant – research and outreach (including its sub-disciplines of extension, education, and communication). The foundation for these disciplines is based on practical need and function.

### *Research*

Minnesota Sea Grant determines critical research directions through facilitated, priority-setting meetings with our advisory committee, as well as exploratory meetings with the university research communities and input from Minnesota citizens and stakeholders. We encourage university faculty to develop collaborative relationships with other academic institutions within and outside of Minnesota, resource management agencies, and industries in developing their proposals. We expect each research project to include an outreach component and encourage research that addresses outreach needs.

Research proposals are reviewed for scientific merit by peers drawn from universities and agencies outside Minnesota. Reviews and proposals are then critiqued by a panel of scientific experts, also from outside the state. Highly-rated proposals are reviewed for relevance to current research and management needs by the Minnesota Sea Grant advisory committee. Scientifically rigorous research proposals considered most appropriate to our programmatic goals are supported within our omnibus program, contingent upon available funding.

### *Outreach*

Outreach staff members work with researchers to ensure that outreach activities are built into research projects funded through our program. Staff also seeks peer reviewers for research proposals and provides valuable input on possible ways to connect research to coastal community needs. Biennially, we conducted staff retreats to review our strategic plan. We also consult our advisory committee, asking them for evaluations and recommendations for incorporating their ideas into our work plans. Staff retreats continue to facilitate our program management, and their results are reflected in this strategic plan.

Our outreach has three subsets: extension, communication and education. Here they are separated to provide an overview. In practice, the subsets overlap through shared ideas, methods, and objectives.

### Extension

Our extension program conducts and evaluates programming within our focus areas to engage in local resource management problems and increase awareness of coastal resource opportunities, conflicts, and decisions. Through such activities as facilitating meetings, organizing symposiums, and conducting outreach projects, our goal is to advance the quality of life of Minnesota's citizens by enhancing Minnesota's environment and economy. Extension plays an active role as a liaison between clientele groups and the research community, alerting researchers to community needs and helping bring university research to the public. We strive to use new technologies in an effective and efficient manner to accomplish our mission and goals.

### Communication

Minnesota Sea Grant uses strategic communication methods to help build and maintain long-term, mutually beneficial relationships with key constituencies. We do this by using the mass media, the World Wide Web, our "Seiche" newsletter, seminars, and event booths to disseminate research results and educational messages, and to develop interest in our program. We also develop marketing plans for our messages, products, and materials to ensure these reach their targeted audiences.

### Education

Sea Grant has become a training ground for skilled researchers and outreach experts in the Great Lakes and Marine Science sub-disciplines. Sea Grant recruits, trains, and employs graduate students, fellows, postdoctoral students, senior researchers, and professionals, helping to build a national "brain trust" to address economic and environmental challenges and opportunities in the coastal arena. Minnesota Sea Grant also remains committed to K-12 education, primarily through teacher training and developing educational resources to ensure that teachers have access to scientifically-sound information regarding coastal economic and environmental issues.

## **Minnesota Sea Grant Clientele and Stakeholders**

### *Advisory Committee*

We continue to cultivate a diverse advisory committee to guide our program. The committee helps us identify coastal resource issues, review research proposals for relevance to local needs, and assists us in disseminating research and outreach results back to the community. The committee is made up of a dozen leaders representing government, businesses, agencies, academia, and other Sea Grant audiences. Their three-year terms are staggered so that one-third of the committee is replaced or re-appointed every year. This allows the committee to become reinvigorated with ideas from new members, while maintaining stability and institutional continuity.

Annually, we ask the advisory committee to identify Great Lakes coastal and Minnesota water resource-related issues that could be aided by research and/or outreach. Issues identified by the advisory committee are compiled, categorized, combined with NOAA's National Sea Grant priorities, and used to help us structure our approach to achieving the goals within each of our four Focus Areas. The expertise of Minnesota Sea Grant clientele and our cooperators are drawn upon to help set programmatic priorities for each two-year proposal cycle. This document is, in large part, a culmination of those interactions.

### *Clientele Groups*

The expertise of Minnesota Sea Grant clientele and cooperators is drawn upon to help set programmatic priorities for each four-year Strategic Planning cycle. Outreach staff identifies and communicates with stakeholder groups to help determine priority areas of emphasis, programmatic objectives, and action plans. Staff talk with committees, commissions, and boards that they serve on or interact with to help determine programmatic priorities. Formal evaluations and surveys seeking information on clientele satisfaction are regularly conducted, and the results are used to polish our products and services. Priority needs collected from these related programs, agencies, and groups are included in this strategic plan. Newsletter reader surveys help keep communication efforts targeted and timely.

### *Regional Outlook*

It has become increasingly important for Sea Grant programs to include a more regional approach to its program activities and strategic planning. Besides efficiency, there are significant gains to be made through cooperative interaction with programs having similar goals, objectives, and desired outcomes – especially given the reasonably consistent bio-geographic province that surrounds all Sea Grant programs concerned with the Great Lakes

Minnesota Sea Grant has cultivated impressive collaborations that belie the program's modest size. A genuine interest in working across borders and managing multi-state and multi-national projects is evident through the program's aquatic invasive species outreach and Great Lakes-St. Lawrence Seaway maritime work. MNSG has been a leader in conducting workshops and organizing opportunities for educators throughout the Great

Lakes region, particularly in support of the Great Lakes Observing System and Centers for Ocean Sciences Education Excellence Great Lakes. Currently, MNSG is managing over \$2.1 million in Great Lakes Restoration Initiative funding on behalf of the Great Lakes Sea Grant Network.

### ***MINNESOTA SEA GRANT'S STRATEGIC APPROACH***

We view our strategic plan as a multifaceted guide reflecting the circumstances and conditions we expect to face over the next four years. Our current strengths and activities give this plan its momentum. Using our expertise and experience, we can successfully apply our lessening resources toward the problems, conditions, and situations identified within this plan. Providing direction to our efforts, this strategic plan points toward bold goals that are achievable through our skill at funding research and our rapport with academia and a broad array of stakeholders.

This strategic plan documents the direction of Minnesota Sea Grant's activities and intentions from 2014-2017. The plan builds on the unique capacities and strengths of the Minnesota Sea Grant staff to address national, regional, and state-based needs in coastal and ocean environments; allows for flexibility and creativity on the part of existing staff; and supports attaining the goals within the focus areas in the National Sea Grant College Program's strategic plan.

The four focus areas that emerged from the strategic planning process of NOAA Sea Grant at the national level are easily transferable to the circumstances and conditions found in Minnesota. These focus areas reflect America's most urgent needs in the ocean and coastal arenas, NOAA priorities, and the strengths and core values of Sea Grant.

#### **Focus Areas**

We adopted the outline of the National Sea Grant Office's strategic plan to create our own with respect to Minnesota waters, coasts, and its citizens' varied environmental, social and economic interests. Focus areas serve to crystallize and energize our response to significant issues brought forth by our stakeholders. Using the National Sea Grant Office's focus areas allows a broader perspective and more imaginative approach toward addressing problems identified as pertinent to Minnesota's waters and coasts. These focus areas resonate with NOAA's mission, are consistent with the work of the NOAA coastal program integration effort, and are areas in which Sea Grant has made and is positioned to make substantial contributions. With reference to Minnesota's aquatic environs, we subscribe to the following four *Focus Areas*:

- I. Healthy Coastal Ecosystems**
- II. Sustainable Fisheries and Aquaculture**
- III. Resilient Communities and Economies**
- IV. Environmental Literacy and Workforce Development**

Each focus area has goals, outcomes and performance measures. The goals describe the desired long-term direction. The outcomes are benchmarks from which Sea Grant can

track progress toward achieving each goal. Performance measures are quantitative ways of measuring outcomes.

Outcomes are commonly categorized as short-, medium- and long-term. In this plan, learning, action, and consequence terminology more easily identifies the transition across outcome categories. For example, progress toward a goal starts with an achievable and measurable learning outcome and is followed by a series of “what happens next” (action and consequence) questions until the goal is met. Using this approach, it is easier to demonstrate in a more or less linear process how goals are achieved.

- **Learning** (short-term) outcomes lead to increased awareness, knowledge, skills, changes in attitudes, opinions, aspirations or motivations through research and constituent engagement.
- **Action** (medium-term) outcomes lead to behavior change, social action, adoption of information, changes in practices, improved decision-making or changes in policies.
- **Consequence** (long-term) outcomes are long-term, and in most cases, require focused efforts over multiple strategic planning cycles. Consequence outcomes in a four-year strategic plan serve as reference points toward reaching focus area goals between the current and future strategic plans.

The outcomes identified in the 2014-2017 National Sea Grant Strategic Plan can only be realized through full utilization of Sea Grant’s research and engagement programs. For example, many of the learning outcomes identified require a substantial investment in needs-based and merit-reviewed research before any actionable outcomes. Simply stated, Sea Grant-sponsored research is the “engine” that leads to new products, tools, or other discoveries used by Sea Grant’s engagement programs to effect change.

There are two types of performance measures identified in this plan. Performance measures specific to focus areas are linked to one focus area and are listed at the end of each focus area section. Cross-cutting performance measures, on the other hand, are broad enough to measure progress toward goals for every focus area. Cross-cutting performance measures are listed following the Education and Workforce Development Focus Area.

The 2014-2017 Minnesota Sea Grant Strategic Plan directly aligns to the 2014-2017 National Sea Grant Strategic Plan and to NOAA’s goals and objectives as articulated in NOAA’s Next Generation Strategic Plan: climate adaptation and mitigation, weather-ready nation, healthy oceans, and resilient coastal communities and economies.

The terms *sustainability*, *sustainably*, and *sustainable* appear throughout this document. These terms have become “buzz words” and mean different things to different people. When we use these terms, we are typically referring to either human community sustainability or ecological sustainability. The following definition for each, taken from the UN Food and Agriculture Organization, represents what we mean when we refer to these terms.

*For humans in social systems or ecosystems, sustainability is the long-term maintenance of responsibility, which has environmental, economic, and social dimensions, and encompasses the concept of stewardship, the responsible management of resource use. In ecology, sustainability describes how biological systems remain diverse, robust, and productive over time, a necessary precondition for the well-being of humans and other organisms.*

## **FOCUS AREAS**

### **I. Focus Area: Healthy Coastal Ecosystems**

Healthy coastal ecosystems are the foundation for life along the coast, but increasingly rapid development, overfishing, and other human activities are leading to water quality degradation, decline of fisheries, wetlands loss, proliferation of invasive species, and other challenges that need to be understood in order to restore and maintain coastal ecosystems. Responsible management of ecosystems requires new kinds of thinking and actions. Sea Grant is a leader in regional approaches to understanding and maintaining healthy ecosystems, with planning efforts underway across the country to identify information gaps, set research priorities, and coordinate information and technology transfer. It has fostered efforts to address widespread problems such as invasive species and harmful algal blooms that are found in geographically-dispersed areas, and has hired staff, shared among several state programs, to tackle these problems. Sea Grant's regional consortia, nationwide networks, and international contacts are particularly suited to helping the nation address ecosystem health at the appropriate local, state, regional, national, and global levels. In particular, Minnesota Sea Grant provides specialized expertise to University of Minnesota Extension and participates in extension research.

Lake Superior is the largest, deepest, coldest, clearest, and in many ways the most pristine of all the waters of the Great Lakes system. Minnesota flanks Lake Superior's western shores and, along with Minnesota Sea Grant, the state's government recognizes the economic and ecological importance of the lake. Minnesota Sea Grant concentrates on Lake Superior and the Lake Superior watershed. Nevertheless, the program also applies effort toward maintaining the health of Minnesota's other natural waters including lakes, wetlands, rivers, and streams. The Mississippi River has its headwaters in the state so Minnesota Sea Grant views the stewardship of this fluvial resource as a national obligation.

Since ecosystem stresses do not adhere to political boundaries, Minnesota Sea Grant values partnerships with geographic neighbors including contiguous states, states that border the Great Lakes, and Canadian provinces.

Given the importance of Minnesota's waters to the residents and visitors of Minnesota, and the prominence that Lake Superior and the Mississippi River play in the greater economy of the United States, Minnesota Sea Grant is devoted to the functional well-being of Minnesota's waters. Changes to these aquatic biotopes can have long-term and far-reaching effects in Minnesota as well as a significant effect on the United States,

Canada, and in the Gulf of Mexico. Minnesota Sea Grant seeks to discover new information and disseminate information relative to the status and trends of the ecosystem functions of the aquatic environment. Monitoring, assessing, and investigating causes and effects of stressors on these biotopes is a critical role that Minnesota Sea Grant plays in facilitating the stewardship of these resources.

**Overall Focus Area Objective: To create, generate, and disseminate scientific information supporting ecosystem-based approaches to managing the coastal environment in Minnesota.**

**1. Goal:** Ecosystem services are improved by enhanced health, diversity and abundance of fish, wildlife and plants.

### **Learning Outcomes**

- 1.1. Develop and calibrate new standards, measures, and indicators of ecosystem sustainability.
- 1.2. Increase public understanding, knowledge, and appreciation of the aquatic environment as a way to improve ecosystem services in coastal areas and encourage preservation and/or restoration.
- 1.3. Identify critical uncertainties that impede progress toward achieving sustainability of ecosystems and the goods and services they provide.
- 1.4. Increase public understanding of climate change science and ecosystem adaptation strategies.
- 1.5. Increase public understanding of the ecosystem threats posed by aquatic invasive species and the importance of preventing or slowing their spread.
- 1.6. Increase community understanding of the economic, social, and ecosystem benefits of removing beneficial use impairments in the St. Louis River Area of Concern.

### **Action Outcomes**

- 1.7. Resource managers, policy- and decision-makers use standards and indicators to support ecosystem-based management.
- 1.8. Aquatic resource users comply with invasive species spread reduction recommendations and regulations.
- 1.9. Decision-makers consider sustainability (e.g., ecosystem health, social health, and economic health) in making decisions related to the environment.

### **Consequence Outcomes**

- 1.10. Ecological systems provide a wide range of ecological, economic, and societal services, and are resilient and able to adapt to change without losing stability.
- 1.11. Greater public stewardship leads to participatory decision-making and collaborative ecosystem-based management decisions.

**2. Goal:** Ecosystem-based approaches are used to manage land, water, and living resources.

### **Learning Outcomes**

- 2.1. Stakeholders have access to data, models, policy information, and training that support ecosystem-based planning, decision-making, and management approaches.
- 2.2. Baseline data, standards, methodologies, and indicators are developed to assess the health of ecosystems and watersheds.
- 2.3. Planners and decision-makers understand environmental model outputs and how to use these outputs to evaluate how their decisions influence ecosystem health.
- 2.4. Residents, resource managers, businesses, and industries understand the effects of human activities and environmental changes on coastal resources, including activities in the watershed.
- 2.5. Resource managers and stakeholders have an increased understanding of the policies that apply to coastal resource protection and restoration.
- 2.6. Stakeholders understand how ecosystem-based management can be used to balance competing interests to protect or restore Lake Superior ecosystems.
- 2.7. Stakeholders understand ecosystem management tools that incorporate environmental, social, and economic benefits.
- 2.8. Communities, businesses, and industries recognize environmental sustainability as being integral to long-term economic profitability.

### **Action Outcomes**

- 2.9. Resource managers evaluate and adopt a range of practical ecosystem-based management approaches for planning and adaptation to future management needs.
- 2.10. Resource managers apply ecosystem-based management principles when making decisions.
- 2.11. State and local government and resource managers incorporate laws, policies, and rules to facilitate and implement ecosystem-based management.
- 2.12. Communities, businesses and industries use environmental sustainability tools or approaches in their decision making processes.

### **Consequence Outcomes**

- 2.13. Land, water, and living resources are managed using ecosystem-based approaches.
- 2.14. Residents, resource managers, and businesses integrate social, natural, and physical sciences when managing resources, and work with all sectors in the decision-making process.

**3. Goal:** Habitats and their ecosystems are protected, enhanced or restored.

### **Learning Outcomes**

- 3.1. Stakeholders, resource managers, and businesses understand the importance of the benefits provided by preserving healthy ecosystems.
- 3.2. Stakeholders, resource managers, and businesses understand the threats to ecosystems and the consequences of degraded ecosystems.
- 3.3. Scientists develop adaptive technologies, tools, and approaches to protect healthy ecosystems and to restore degraded ecosystems.
- 3.4 Scientists identify stressors (including cumulative environmental factors) on the coastal ecosystem and their level of interaction in influencing coastal ecosystem structure, function, and resiliency.
- 3.5. The public and stakeholders understand the meaning of ecosystem resiliency.

### **Action Outcomes**

- 3.6. Resource managers set realistic and prioritized goals to protect, enhance, and restore habitats by incorporating scientific information and public input.
- 3.7. Resource managers, businesses, and stakeholders adopt innovative approaches and technologies to maintain, protect, or restore ecosystems.
- 3.8. Resource managers set goals and prioritize actions based on an understanding of ecosystem resiliency.

### **Consequence Outcomes**

- 3.9. Critical habitats are protected via adaptive management techniques that take climate change scenarios into consideration.
- 3.10. Degraded ecosystem function and productivity are restored.

### **Healthy Coastal Ecosystem Performance Measures**

1. Number of Sea Grant tools, technologies, and information services that are used by our partners/customers to improve ecosystem-based management.
2. Number of times ecosystem-based approaches are used to manage land, water, and living resources in coastal areas as a result of Sea Grant activities.
3. Number of acres of coastal habitat protected, enhanced, or restored as a result of Sea Grant activities.
4. Number of stakeholders/ communities/ watershed groups trained to better understand issues associated with healthy ecosystems, their resiliency to a changing climate, and the threats of aquatic invasive species.

## **II. Focus Area: Sustainable Fisheries and Aquaculture**

Seafood safety is a growing concern as international trade increases and fish diseases and contamination become bigger problems. Sea Grant has obligations to advance the nation's understanding of fish consumption advisories, the benefits of eating fish, organic labeling, and the risks and benefits of creating genetically modified fish for food and management. Through the use of its research, extension, and education capacities, Sea Grant supports decision-making that will sustain a safe supply of seafood through the next century.

The U.S. has witnessed the decline of many of its major fisheries, yet seafood consumption is rising, resulting in a seafood trade deficit of \$8 billion per year according to U.S. Department of Agriculture Foreign Agricultural Service statistics in a 2005 international trade report. At the same time, Sea Grant, through its research, extension, and education activities and work with partners, has made important discoveries that have aided the stabilization and recovery of many endangered fisheries.

Aquatic foods, derived from both commercial and recreational sources, are paramount in Minnesota's past, present, and future. Lake Superior's relatively pristine waters serve as habitat for a variety of fish stocks that include lake trout, cisco, whitefish, deepwater

chubs, salmon, and smelt. Other foods directly harvested from Minnesota waters and considered important by the public include walleye, crayfish, and wild rice.

Maintaining the size, extent, number, and quality of these aquatic food resources is paramount for a sustained, preferred lifestyle for Minnesota's populace. While the condition of these resources is important, the ability of their respective fisheries to handle, transport, prepare, and serve these food items is also crucial. Minnesota Sea Grant seeks to maintain and improve the availability and condition of these resources and abilities.

According to the NOAA Aquaculture Program, aquaculture is in its infancy in the U.S., amounting to just over \$1 billion of a \$70 billion worldwide industry. Aquaculture creates opportunities to meet the increased demand for aquatic foods and also the demand for baitfish for the recreational fishing industry. Aquaculture in Minnesota deserves further development and encouragement.

**Overall Focus Area Objective: To assist in generating a sustainable supply of safe foods and other products from aquatic environs (both wild and domestic) for commercial harvest, aquaculture, and recreational fisheries.**

**4. Goal:** A safe, secure, and sustainable supply of seafood to meet public demand.

#### **Learning Outcomes**

- 4.1. Fishery managers and fishermen understand the dynamics of wild fish populations.
- 4.2. The seafood industry is knowledgeable about innovative technologies, approaches, and policies.
- 4.3. Commercial and recreational fishermen are knowledgeable about efficient and responsible fishing techniques.
- 4.4. The commercial fishing industry is aware of innovative marketing strategies to add value to its product.
- 4.5. The seafood processing industry learns and understands economically viable techniques and processes to ensure the production and delivery of safe and healthy seafood.

#### **Action Outcomes**

- 4.6. The seafood industry adopts innovative and efficient technologies and approaches to supply safe and sustainable seafood.
- 4.7. The commercial fishing and aquaculture industries adopt innovative marketing strategies to add value to their products.
- 4.8. The seafood industry adopts techniques and approaches to minimize the environmental impact of their sectors.
- 4.9. Resource managers establish policies and regulations that achieve a better balance between economic benefit and conservation goals.
- 4.10. The seafood processing industry implements innovative techniques and processes to create new product forms and ensure the delivery of safe and healthy seafood.

### **Consequence Outcomes**

- 4.11. The Minnesota seafood supply is sustainable and safe.
- 4.12. There is an expansion of the sustainable domestic fishing and aquaculture industries.

**5. Goal:** Informed consumers who understand the health benefits of seafood consumption and how to evaluate the safety and sustainability of the seafood they buy.

### **Learning Outcomes**

- 5.1. The seafood industry is aware of the standards for safe seafood.
- 5.2. The seafood industry is knowledgeable about consumer trends regarding seafood sustainability and safety, and how to adjust operations to meet emerging demands.
- 5.3. Minnesota seafood consumers have increased knowledge to evaluate sustainable seafood choices.
- 5.4. Minnesota seafood consumers have an increased knowledge of the nutritional benefits of seafood products, especially for Great Lakes freshwater fish, and know how to judge seafood safety and quality.

### **Action Outcomes**

- 5.5. The seafood industry adopts standards for safe seafood.
- 5.6. The seafood industry adopts technologies and techniques to ensure seafood safety.
- 5.7. Minnesota seafood consumers preferentially purchase sustainable seafood products.
- 5.8. Minnesota anglers (including immigrant populations) understand fish consumption advisories and use them when they make decisions regarding consumption of the fish they catch.

### **Consequence Outcomes**

- 5.9. Consumers increase their consumption of safe and sustainable seafood products.
- 5.10. The Minnesota seafood industry operates sustainably and is economically viable.

**6. Goal:** Economically viable and environmentally safe aquaculture contributes food and fish for stocking, baitfish, and ornamental fish.

### **Learning Outcomes**

- 6.1. Baitfish and other aquaculture industries in Minnesota better understand new markets and sustainable culture techniques.
- 6.2. Industry representatives understand the viability of new systems for farming baitfish and other species.
- 6.3. Minnesota fish farmers better understand the impacts that a changing climate may have on outdoor fish farming.

### **Action Outcomes**

- 6.4. The Minnesota aquaculture industry provides fish for food, for stocking, and for bait in an environmentally and economically viable manner.

### **Consequence Outcomes**

6.5. The aquaculture industry operates sustainably and is economically viable.

### **Sustainable Fisheries and Aquaculture Performance Measures**

5. Number of fishermen, seafood processors and aquaculture industry personnel who modify their practices using knowledge gained in fisheries sustainability and seafood safety as a result of Sea Grant activities.

6. Number of seafood consumers who modify their purchases using knowledge gained in fisheries sustainability, seafood safety, and the health benefits of seafood as a result of Sea Grant activities.

### **III. Focus Area: Resilient Communities and Economies**

As the interface between land and water, shorelines serve as the platform for numerous activities (both recreational and commercial) that constitute a way of life for Minnesotans. As development continues along Minnesota's river and lake shorelines, Minnesotans are increasingly aware that profound changes are happening to coastal habitats. Few Minnesotans understand that economic sustainability requires environmental sustainability, particularly around shorelines where the quality of the environment correlates with property values.

Minnesota Sea Grant helps coastal communities understand the development options available to them and the consequences of development decisions on the environment, economy, and society. Today's development patterns set the stage for how community infrastructure will function in the future, as well as help determine a community's resilience to environmental hazards related to climate change and other phenomena.

Changes in Minnesota's coastal communities have transformed landscapes and intensified demand on finite coastal resources. New housing developments and recreation facilities, a new generation of energy development activities, port expansions, and other business activities are affecting coastal lands, water supplies, and traditional ways of life. To balance growing demands on coastal resources, we must develop new policies, institutional capacities, and management approaches to guide the preservation and use of coastal and Great Lakes resources. Minnesota Sea Grant will engage a diverse coastal population in applying the best available scientific knowledge by using its outreach capabilities to support the development of healthy coastal communities that are economically and socially inclusive, encompass varied and vibrant economies, and function within the carrying capacity of their ecosystems.

Residents of coastal communities need to understand the risks of living near large waterbodies, and learn what they can do to reduce their vulnerability and respond quickly and effectively when hazardous events occur. Sea Grant will use its integrated research, training, and technical assistance capabilities, and its presence in coastal communities to help citizens, decision-makers, and industries plan for hazardous events and optimize the ability of their communities to remain physically, economically, and environmentally stable through hazardous conditions.

Large-scale hazards and extreme events can have a devastating effect on communities, and Minnesota's coasts are not immune from these effects. Flooding, droughts, rip currents, pollution (by way of spills or non-point pollution), severe storms, harmful algal blooms, anoxia, seiches, and global climate change stress our coasts. Our inability to predict the timing, location, or severity of such events much in advance means that we can only rely on their inevitability. Each hazard comes with its own range of impacts and its own temporal and spatial scales of influence.

Minnesota Sea Grant has an obligation to its constituents to relay reliable information about the potential presence and impact of these events and hazards so that people can respond in ways to protect their properties, livelihood, and health. Climate change has been identified as an area that requires special attention with regard to informing the public. Planning for the future, assisting with recovery, and minimizing risks are avenues through which Minnesota Sea Grant can help coastal communities remain resilient.

**Overall Focus Area Objective: To foster sustainable, resilient, and thriving coastal communities that successfully balance economic development and environmental protection while preparing for threats and hazards.**

**7. Goal:** Development of vibrant, resilient, and sustainable coastal economies.

#### **Learning Outcomes**

7.1. Communities are aware of the economic value of coastal ecosystems and the interdependence between the health of the economy and the health of natural and cultural systems.

7.2. Communities have access to information needed to understand the value of waterfront and tourism-related economic activities.

7.3. Communities understand the strengths and weaknesses of alternative development scenarios on resource consumption and sustainability of the local environment and economy.

7.4. Communities are aware of regulatory regimes affecting economic and environmental sustainability.

7.5. Communities are knowledgeable about ecological and economic cost/benefit analysis associated with climate adaptation, energy planning, and conservation.

7.6. Affected users understand the potential impacts to commerce from persistent drought and more frequent intense storms and drought impacts on water levels and sediment deposition in shipping channels and local harbors.

#### **Action Outcomes**

7.7. Communities engage in economic development initiatives that capitalize on the value of their natural and cultural resources while balancing ecosystem sustainability and resource conservation with economic growth.

7.8. Communities have prepared for extreme weather events to provide safety and resiliency to the greatest extent possible.

7.9. Port and harbor managers and resource managers are prepared for the long-term trends associated with water level fluctuations, dredging needs, and runoff issues that result from a changing climate.

### **Consequence Outcomes**

7.10. Communities have resilient ecosystems and healthy economies that support working waterfronts and the natural environment.

7.11. Climate adaptation preparedness and coastal hazard event planning help communities return to normalcy more quickly and in a more cost-efficient manner.

**8. Goal:** Communities use comprehensive planning to make informed strategic decisions that move systems toward resiliency from extreme events as well as long-term trends.

### **Learning Outcomes**

8.1. Community leaders understand the connection between planning and natural resource management issues, and make management decisions that minimize conflicts, improve resource conservation efforts and identify potential opportunities for natural resource protection and restoration.

8.2. Community leaders are aware of the ecological services provided to their community and the role of sustainable economic, agricultural, and environmental practices in maintaining these benefits.

8.3. Community awareness of climate change enables them to establish adaptive measures to protect their economy, environment, and health.

8.4. Community leaders are aware of the tipping points for their own watersheds, including current land use impacts and future projections.

### **Action Outcomes**

8.5. Communities make use of Sea Grant-generated tools and information to explore the different patterns of coastal development, including community visioning exercises, resource inventories, and coastal and land-use planning.

8.6. Communities adopt or update and revise coastal and land-use plans to reflect their long-term goals, and those plans include climate change considerations.

8.7. The public, leaders, and businesses work together to implement plans for the future and to balance multiple uses of coastal areas.

8.8. Community leaders use tipping points to develop or update plans and policies to better protect resources.

### **Consequence Outcomes**

8.9. Quality of life in communities, as measured by economic and social well-being, improves along with an improved environment through prevention and protection of intact ecosystems as well as restoration and elimination of adverse impacts to degraded ecosystems.

**9. Goal:** Improvements in coastal water resources sustain human health and ecosystem services.

### **Learning Outcomes**

- 9.1. Citizens are aware of the impact of human activities on water quality and supply.
- 9.2. Citizens understand the value of clean water, adequate supplies, and healthy watersheds.
- 9.3. Community leaders recognize the important role of their local policies in protecting and improving the quality of aquatic resources within their watershed.

### **Action Outcomes**

- 9.4. Communities adopt adaptation and mitigation measures, best management practices, and improved site designs in local policies and ordinances to address water supplies and water quality.
- 9.5. Communities engage in planning efforts to protect aquatic resources and improve water quality.

### **Consequence Outcomes**

- 9.6. Water quality improves.
- 9.7. Aquatic resources are protected and restored where needed.
- 9.8. Aquatic ecosystem services are maintained.

**10. Goal:** Resilient coastal communities manage and adapt to the impacts of hazards and climate change.

### **Learning Outcomes**

- 10.1. Residents and decision-makers are aware of and understand the processes that produce hazards, including those resulting from a changing climate, and the implications of those processes for them, their infrastructure, and their communities.
- 10.2. Decision-makers are aware of existing and available hazard- and climate-related data and resources, and have access to the information and skills to assess local vulnerability.
- 10.3. Communities have access to data and innovative and adaptive tools and techniques to aid them in minimizing hazardous risks and the negative impacts associated with those hazards.
- 10.4. Decision-makers understand the legal and regulatory regimes affecting climate adaptation, including coastal and riparian property rights, disaster relief, and insurance issues.
- 10.5. Communities understand the role of public outreach and education in informing citizens and coastal user groups of the risks of living, working, and recreating on or near coastal waterways.

### **Action Outcomes**

- 10.6. Communities develop, adopt, and/or apply best available hazards and climate change information, adaptation strategies, tools and technologies in the planning process.
- 10.7. Decision-makers apply data, guidance, policies, and regulations in hazard planning and climate change adaptation and mitigation projects and programs.
- 10.8. Stakeholders, coastal user groups, and businesses take action to reduce the impact of coastal hazards on their life and property.

10.9. Communities adopt a comprehensive risk communication strategy for hazardous events.

### **Consequence Outcomes**

10.10. Communities effectively prepare for hazardous events and climate change.

10.11. Communities are resilient and experience minimum disruption to life and economy following hazardous events.

10.12. Communities are socially, economically, and environmentally sustainable.

### **Resilient Communities and Economies Performance Measures**

7. Number of communities that implemented sustainable economic and environmental development practices and policies (e.g., land-use planning, working waterfronts, energy efficiency, climate change planning, smart growth measures, green infrastructure) as a result of Sea Grant activities.

8. Number of communities that implemented hazard resiliency practices to prepare for, respond to, or minimize coastal hazardous events as a result of Sea Grant activities.

## **IV. Focus Area: Environmental Literacy and Workforce Development**

The America COMPETES Act mandates that NOAA build on its historic role in stimulating excellence in the advancement of ocean and atmospheric science and engineering disciplines. The Act also mandates NOAA provide opportunities and incentives for the pursuit of academic studies in science, technology, engineering, and mathematics.

Minnesota Sea Grant is committed to not only increasing student success in STEM (science, technology, engineering, and mathematics) disciplines, but also increasing emerging scientists' capabilities and commitment to interacting and communicating with non-technical audiences. Fulfilling the commitment expressed in the Great Lakes Restoration Initiative (GLRI) to "create a new standard of care that will leave the Great Lakes better for the next generation" requires the full involvement, engagement, and commitment of Great Lakes scientists AND citizens to stewardship of the watersheds affecting the lakes. Engaging citizens, especially students and educators, in "place-based" learning (stewardship and hands-on, real-world learning experiences in their local environment) is a well-documented approach to not only increase academic achievement, but also to develop stronger connections to community and natural resources, leading to active, contributing citizens (Sobel 2004).

As the National Sea Grant Plan states, "An environmentally literate person is someone who has a fundamental understanding of the systems of the natural world, the relationships and interactions between the living and non-living environment and the ability to understand and utilize scientific evidence to make informed decisions regarding environmental issues. These issues involve uncertainty and require the consideration of economic, aesthetic, cultural and ethical values." Minnesota Sea Grant seeks to help bridge the gap between STEM and social science disciplines provide better-integrated

learning opportunities about the relationship between human decisions and environmental sustainability.

**Overall Focus Area Objective: To increase ocean and Great Lakes literacy among Minnesota students and teachers, and increase the ability and capacity for citizens to understand and use scientific evidence to make informed decisions regarding environmental issues.**

**11. Goal:** An environmentally literate public supported by a continuum of lifelong formal and informal engagement opportunities.

### **Learning Outcomes**

11.1. Formal and informal educators are knowledgeable of the best available science on the effectiveness of environmental science education.

11.2. Formal and informal educators understand environmental literacy principles.

11.3. Citizens are able to engage in informal science education opportunities focused on coastal topics.

11.4. Rural classrooms have increased availability of high quality science and environmental education programming.

11.5. There are teacher training opportunities within the Lake Superior watershed that make the connections about watershed implications to the coastal areas and Lake Superior.

### **Action Outcomes**

11.6. Extension professionals and formal and informal education programs incorporate environmental literacy principles in their programs.

11.7. Extension programs are developed and refined using the best available research on the effectiveness of environmental and science education.

11.8. Formal and informal education programs take advantage of the knowledge of Sea Grant-supported scientists and extension professionals.

11.9. Formal and informal educators, students and/or the public collect and use coastal, weather, and climate data in inquiry and evidence-based activities.

11.10. Citizens make choices and decisions based on information they learned through informal science education opportunities.

11.11. Educators work cooperatively to leverage federal, state and local investments in coastal environmental education.

11.12. Environmentally-based long-distance learning is available through regional, interactive videoconference programming.

### **Consequence Outcomes**

11.13. Citizens are scientifically literate, understand the impact of their land use decisions on water resources, and incorporate their knowledge into action on the environment and into personal and community-wide decisions that impact the environment.

**12. Goal:** A future workforce reflecting the diversity of the Sea Grant programs, skilled in science, technology, engineering, mathematics and other disciplines critical to local, regional, and national needs.

### **Learning Outcomes**

12.1. Students and teachers are aware of opportunities to participate in science, technology, engineering, mathematics, and active stewardship programs.

12.2. Students and teachers in northern Minnesota become more aware of issues related to Lake Superior through an on-going partnership with the Great Lakes Aquarium and through teacher training initiatives.

12.3. Minnesota Sea Grant works with Minnesota STEM groups so that Sea Grant can contribute a strong marine/aquatic presence in curriculum production and classroom teaching.

### **Action Outcomes**

12.4. A diverse and qualified pool of applicants pursues professional opportunities for career development in natural, physical, and social sciences and engineering.

12.5. Graduate students are trained in research and engagement methodologies.

12.6. Research projects support undergraduate and graduate training in fields related to understanding and managing our coastal resources.

12.7. Teachers are more skilled in teaching about marine and aquatic science and students graduate with a better knowledge of marine and aquatic science.

### **Consequence Outcomes**

12.8. A diverse workforce trained in science, technology, engineering, mathematics, law, policy. or other fields is employed and has high job satisfaction.

### **Environmental Literacy and Workforce Development Performance Measures**

9. Number of Sea Grant-facilitated curricula adopted by formal and informal educators.

10. Number of people engaged in Sea Grant-supported informal education programs.

11. Number of Sea Grant-supported graduates who become employed in a career related to their degree within two years of graduation.

12. Number of graduate and undergraduate students trained on Sea Grant research and outreach activities.

13. Number of teachers and informal instructors who have participated in Sea Grant-supported science education enrichment programs.

14. Number of students who have been exposed to Great Lakes literacy because of Sea Grant-sponsored science education enrichment programs.

15. Number of undergraduate and graduate students in STEM and the social sciences who have conducted outreach related to their field of study.

16. Number of science education undergraduates (pre-service) who have been introduced to and gained experience in teaching Great Lakes Literacy Principles.

## **DEVELOPMENT AND IMMEDIATE RESPONSE CAPABILITIES**

Sea Grant programs are fortunate to be flexible in their programming to provide funds that encourage the development of new and innovative ideas as well as respond to immediate response circumstances that are largely unpredictable. Minnesota Sea Grant includes here, as part of its strategic plan, the formal recognition of this program-specific feature that makes Sea Grant a unique federal/state cooperative effort.

Minnesota Sea Grant will provide, on an as-needed and on an as-affordable basis, funds to encourage the development of research and outreach projects that meet the overall objectives of its strategic plan. Also on an as-needed and as-affordable basis, our program will support research and outreach efforts that will provide valuable information regarding the effect and extent of natural hazards and extreme conditions.

This part of our program is meant to be distinct from our traditional grant-cycle program. As part of its development and immediate response capabilities, our program will act to facilitate efforts that meet the overall objectives of our program given the constraints of responsiveness, immediacy, and importance to our overall mission.

## **CROSS-CUTTING PERFORMANCE MEASURES**

17. Economic (market and non-market; jobs and businesses created or retained) benefits derived from Sea Grant activities.

18. Number of peer-reviewed publications produced by Sea Grant staff and researchers, and number of citations for all peer-reviewed publications from the last four years.

## **IMPLEMENTATION STRATEGY**

This strategic plan aligns with the National Sea Grant Strategic Plan, with particular focus on the specific needs and priorities of Minnesota and the Great Lakes region. Our 2014-2017 Sea Grant Strategic Plan will be implemented through merit-reviewed research, communications, education, extension, and legal projects. This implementation strategy takes advantage of Sea Grant's unique combination of research and engagement capabilities and capitalizes on its strong federal-university-state-private sector partnerships. We will revisit this plan yearly to ensure that the organization is accomplishing its four-year goals while staying alert to new trends and opportunities.