

# Sea Grant Association

## Sea Grant's "Community Resilience to Natural Disasters" Program

### Enhancing Community Resilience to Natural Disasters through Science-based Planning, Mitigation, Restoration, and Education

**Background:** Coastal areas of the U.S. comprise only 10 percent of our land mass, and yet they are home to more than 54 percent of Americans. Risks to life, property, and the environment from coastal natural hazard events will increase with growth of coastal populations over the next several decades. Unprecedented hurricane damage and personal despair during 2005 has tested government at all levels, and has left many unanswered questions regarding the level of our preparedness to deal with and respond to disasters of this magnitude.



Hurricanes, typhoons, and tsunamis are compounded by other trends, including coastal inundation (due to rising sea level and land subsidence), increasing storm intensity, uneven enforcement of building codes, lack of adequate zoning ordinances, poor planning and construction, continued development in high risk areas, and the inexperience of coastal dwellers to prepare for and recover from these events. Despite significant progress in the application of science and technology to disaster reduction, communities remain challenged by

disaster preparation, response, and recovery (NSTC 2005). These observations underscore the need for a dedicated national effort to provide science-based information towards the reduction of the social, economic, and environmental costs of natural hazards to our coastal communities.

**Program Goal:** The National Science and Technology Council's (NSTC) 2005 document, *Grand Challenges for Disaster Reduction* offers six Grand Challenges for sustained Federal investment in science and technology related to disaster reduction. The goal of Sea Grant's program is to join with its diverse partners<sup>1</sup> to provide university-based research, extension, and education programs, based on the six *Grand Challenges*, to enhance community preparedness and reduce the loss of human life, property, and ecological resources from coastal natural hazards in the United States.

**Program Objectives:** Sea Grant will join with its partners in government, business, industry, and schools to

- Assess the threats facing the nation's coastal regions from future coastal hazards and storms,
- Generate science-based information to improve understanding about natural hazards phenomena,
- Develop educational/public awareness initiatives to transfer research information to emergency preparedness and planning officials, local government personnel, and the general public.

**Budget Request:** Sea Grant's **Community Resilience to Natural Disasters** program is planned as a \$6 million/year investment over a five-year period.

**Benefits:** The events preceding and subsequent to the 2005 storm season have underscored the need for greatly improved information transfer to enable and empower communities to better plan, prepare, respond, and rebuild. To address these needs, Sea Grant will engage its network of more than 200 universities and laboratories to address critical research needs, and employ its existing nationwide coastal community outreach and education program network, which now reaches municipalities in and beyond the nation's 673 coastal counties, boroughs, and parishes, to provide "resilient community" services and products. Sea Grant's collective contributions in these situations can be greatly enhanced through a comprehensive strategic research, education, mitigation, and planning program.

<sup>1</sup> Including the NOAA Coastal Services Center, NOAA National Weather Service, U.S. Geological Survey, Federal Emergency Management Agency, Institute for Building and Home Safety, National Homebuilders Association, National Emergency Management Association, Association of State Floodplain Managers, National Association of Counties, National League of Cities, Coastal States Organization, National Federation of Regional Associations (IOOS), and American Planning Association.

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### Program Objectives – Sea Grant's Role

#### Coastal Hazard Identification and Risk Assessment:

- Evaluate and improve structural and non-structural components and systems used in residential construction for resistance to hazard-induced loads (from winds and flooding) and their ability to protect the structure's envelope and foundation.
- Investigate hazard vulnerability (including wind, surge and inundation impacts) through risk identification and assessment, incorporating factors of uncertainty, biophysical elements and socio-economic impacts into planning and assessment models and decision-support tools.
- Generate hazards-based environmental/ecological information through research and monitoring programs and establish community level baseline environmental data for use in pre- and post-disaster assessments.

#### Community-based Applied Research and Technology Transfer:

- Expand Sea Grant's capacity to respond to coastal communities requests for assistance in understanding the environmental and ecological consequences of various development scenarios, particularly as they relate to potential disaster exposure and risk.
- Working with the Institute of Building and Home Safety, enhance awareness among home builders, design professionals, building officials, elected leaders, lenders, insurers and homeowners on newly developed, tested and cost-effective methods and materials for building new and retrofitting existing structures for enhanced resistance to hazards.
- Provide information and training to local community officials, in partnership with the American Planning Association and its state chapters, to implement land use policies under the rubric "Smart Growth, Safe Growth" that (1) protect and restore critical environmental/ecological buffers against intense storms, (2) guide development and redevelopment activities toward areas that are less vulnerable to coastal hazards, and (3) avoid development that contributes to structural vulnerability, coastal erosion and wetland loss.
- Develop and deliver products generated on hazards mapping (especially for floods and inundation), risk analysis and other mitigation-related research to governmental decision makers as a guide to policy development and community planning to reduce total costs of future natural hazard events.

#### Public Awareness, Training and Education:

- Monitor and assess public awareness and acceptance of hazard mitigation measures in selected communities over time and, with the National Hazards Center, evaluate the impact of education efforts on this awareness.
- Develop and deliver targeted, community-level educational programs to inform local and state governments, the private sector and the general public of the true costs of natural hazard events.
- Create extension education programs specifically designed to address hazard-related needs and mitigation responsibilities of traditional Sea Grant constituent groups, with a focus on coastal communities, local governments, the seafood industry, ports and harbors, and other coastal and marine-related businesses.

#### Resources, Leadership and Coordination:

- Evaluate and analyze incentive and policy alternatives that seek to encourage mitigation and safe growth strategies at all government levels, as well as among manufacturers, lending institutions, insurance companies, home builders and among individual homeowners.
- Identify and recommend innovative financial incentives that can be used by both the private sector and government to decrease costs and reduce risks.
- Examine ways in which mitigation planning is being effectively incorporated into public policy and planning decisions.
- Create communications strategies to encourage (1) acceptance by the nation's citizenry of the need to take personal responsibility for protecting themselves, their property and their community against personal and public losses due to natural hazards, and (2) a public demand for effective mitigation measures.
- Sea Grant, in collaboration with its partners, will develop a "Risk-Wise" educational program for local decision-makers to improve the safety and resiliency of communities threatened by coastal hazards.

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### Enhancing Community Resilience to Natural Disasters through Science-based Planning, Mitigation, Restoration, and Education

#### Objectives, Tasks, and Performance Metrics

##### Coastal Hazard Identification and Risk Assessment:

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- Investigate hazard vulnerability (including wind, surge and inundation impacts) through risk identification and assessment, incorporating factors of uncertainty, biophysical elements and socio-economic impacts into planning and assessment models and decision-support tools.
- Generate hazards-based environmental/ecological information through research and monitoring programs and establish baseline environmental data at the community level for use in pre- and post-disaster assessments.
  - **Task:** Sea Grant will evaluate existing planning and zoning ordinances and assist local communities in ordinance development and revision to enhance preparedness, planning, response, and environmental restoration efforts.
  - **Performance measure:** Number of coastal communities with improved ability to reduce the adverse impacts of coastal natural hazards on people, structures, and the environment.



##### Community-based Applied Research and Technology Transfer:

- Expand Sea Grant's capacity to respond to coastal communities requests for assistance in understanding the environmental and ecological consequences of various development scenarios, particularly as they relate to potential disaster exposure and risk.
- Working with the Institute of Building and Home Safety, enhance awareness among home builders, design professionals, building officials, elected leaders, lenders, insurers and homeowners on newly developed, tested and cost-effective methods and materials for building new and retrofitting existing structures for enhanced resistance to hazards.
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- Develop and deliver products generated on hazards mapping (especially for floods and inundation), risk analysis and other mitigation-related research to governmental decision makers as a guide to policy development and community planning to reduce total costs of future natural hazard events.



- **Task:** Sea Grant extension specialists will partner with organizations (e.g., American Planning Association, Institute for Building and Home Safety, etc.) to identify and transfer research and technical information to state and local governments.
- **Performance measure:** Number of coastal communities with improved ability to reduce the adverse impacts of coastal natural hazards.

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- **Task:** During the next five years, Sea Grant will sponsor directed research in the areas of physical oceanography and hydrology (e.g., to improve storm surge and inundation modeling and prediction), wind engineering (e.g., to improve hazard-resistant construction techniques), coastal ocean studies (e.g., to model and predict changes in shoreline characteristics related to erosion), and coastal habitat reconstruction (e.g., for mitigation of storm events and critical habitat replacement).
  - **Performance measure:** Cumulative number of tools and technologies developed that improve the hazard resiliency of coastal communities, ecological resources, and targeted SG constituencies.
- **Task:** Sea Grant will sponsor research to develop fill gaps in storm surge and inundation (surge plus waves on top of surge) predictors for use by communities in planning and the development of zoning and (re-)building ordinances.
  - **Performance measure:** Number of decision makers trained in hazard mitigation best practices.



### Public Awareness, Training and Education:

- Monitor and assess public awareness and acceptance of hazard mitigation measures in selected communities over time and, with the National Hazards Center, evaluate the impact of education efforts on this awareness.
  - Develop and deliver targeted, community-level educational programs to inform local and state governments, the private sector and the general public of the true costs of natural hazard events.
  - Create extension education programs specifically designed to address hazard-related needs and mitigation responsibilities of traditional Sea Grant constituent groups, with a focus on coastal communities, local governments, the seafood industry, ports and harbors, and other coastal and marine-related businesses.
- **Task:** Sea Grant will develop educational materials and programs for use by students and teachers in formal classroom and informal learning settings.
    - **Performance measure:** Number of students and teachers reached with natural hazards educational programs and materials.

**FORMING HURRICANES**

**What is a Hurricane ?**  
A hurricane is the most intense form of a tropical cyclone with sustained winds exceeding 130 kilometers per hour (75 mph) that rotate around a strong atmospheric low-pressure system. Hurricanes are accompanied by several hazards (swells, surfs) of the ocean, hurricanes spin counter-clockwise in the northern hemisphere. The wind comes from the Gulf of Mexico.

**Anatomy of a Hurricane**  
Eye: The hurricane's center can be eerily clear and calm even, but people to see that view above. It can be as large as 60 kilometers (40 miles) across.  
Eyewall (also called the Wall Cloud): The dense wall of thunderclouds that define the eye from the highest wind speeds and controls the size of the eye.  
Rainbands: The outer and less severe bands of thunderstorms can range in width from 80 to 500 kilometers (50 to 300 miles).

**What causes Hurricanes ?**  
Atlantic hurricanes form from atmospheric disturbances, usually at the west coast of Africa but also in the Caribbean Sea and Gulf of Mexico. Disturbances form in the tropical Pacific. Other features: Hurricanes are fueled by water evaporation from warm ocean water (27°C, 80°F). These vapors from clouds and rain that warm the surrounding air. Higher temperatures and light and evaporation, the system intensifies leaving warm and to move toward the pressure center. The air spirals inward and upward of the rotating Earth (Coriolis) causing the storm to grow. The energy organizes into bands of thunderstorms that spiral inward and outward of the low-pressure center enclosing the eye. Hurricanes can last few weeks over warm ocean waters, but will fade over cooler waters or land. Ocean observing systems provide vital data to scientists indicating when and where hurricanes form, intensify, and move. This information is used for hurricane preparedness (evacuations) and research.

**The Saffir-Simpson Hurricane Scale**  
Rates hurricane's intensity based on sustained wind speed, and provides an estimate of potential property damage and flooding.

Hurricane Category	Wind Speed (km/h)	Storm Surge (m (ft))
Tropical Depression	< 62 (39)	< 1.5 (4.9)
Tropical Storm	62-118 (39-73)	< 1.5 (4.9)
1	119-153 (74-96)	1.5 (5)
2	154-177 (96-110)	2.5 (8)
3	178-209 (111-130)	3.7 (12)
4	210-249 (131-155)	5.5 (18)
5	> 249 (156)	> 5.5 (18)

**Hazards of a Hurricane**  
High Winds: The hazard most associated with hurricanes are defined under the Saffir-Simpson scale (to the right). Hurricane-force winds can easily destroy poorly constructed buildings.  
Storm Surge: A rapid rise in sea level forced on land by high winds that cause flooding. Storm surges are the worst of hurricane hazards, claiming the most fatalities.  
Heavy Rain: Rainfall levels of 15-30 centimeters (6-12 inches) are common, but can reach 110 centimeters (43 inches). Heavy rainfall can lead to significant flooding in low-lying areas.  
Tornadoes: Over half of the hurricanes that reach land produce at least one tornado. These tornadoes tend to be less intense than those occurring in the Great Plains.  
For Hurricane Safety and Preparedness Guides, please visit <http://www.sea.gov/seagrants/hurricane/hurricane.pdf> and <http://www.fema.gov/emergency>.

**SouthEast Atlantic Hurricane Facts**  
• The official Atlantic hurricane season begins on June 1 and ends November 30, but peak season is from mid-August until October.  
• The naming of hurricanes using alternating male and female names and moving through the alphabet began in 1979. There are 6 lists of names rotated every 6 years that are used by the National Hurricane Center. These have been endorsed by the World Meteorological Organization.  
• On average, 5 hurricanes make landfall from Maine to Texas every 3 years. However in 2004, 8 storms brought hurricane conditions ashore from North Carolina to Florida alone (shown on figure to left).  
• Since 1950, 48 hurricanes have made landfall from North Carolina to Florida. Of those, 16 were major (Category 3-5). Hurricanes in 2004 caused 117 deaths and \$42 billion in damage in the U.S. alone.  
• Symbols define areas where hurricanes were over land and water. The Hurricanes were: **John**, **Charley**, **Fabian**, **Opal**, **Ivan** and **Jeanne**.  
Storms bringing hurricane conditions ashore from North Carolina to Florida. Symbols define areas where hurricanes were over land and water. The Hurricanes were: John, Charley, Fabian, Opal, Ivan and Jeanne.

For Classroom lessons and hurricane information: [www.seacoos.org](http://www.seacoos.org) Southeast Atlantic Coastal Ocean Observing System

- **Task:** A Web-based portal containing links to university-based technical and extension publications, fact sheets, Web sites, electronic media and other information will be developed in 2005 as a component of the Sea Grant network's HazNet Web site ([www.haznet.org](http://www.haznet.org)).
- **Performance measure:** Number of user interactions with HazNet web pages.

- **Task:** Sea Grant will sponsor science-based outreach programs in local communities for targeted constituent groups on the importance of maintaining and restoring estuarine, wetland, beach and dune habitat as a means of reducing impacts from natural hazard events.

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- **Performance measure:** Number of local government officials, technical staff, and volunteers trained in hazard mitigation "best practices."
- **Task:** Sea Grant will coordinate and implement a well-integrated national outreach strategy (through Sea Grant Extension and involving the Extension Hazards Education Network) for use by Federal agencies (NOAA, FEMA, USGS, USEPA, etc.) to deliver relevant coastal disaster preparedness education and science-based information products to communities and local government officials.
  - **Performance measure:** Number of federal agency personnel engaged in delivering science-based information to local communities.
- **Task:** Sea Grant will provide outreach programs to train local communities on how to preserve and restore estuarine, wetland, beach and dune habitat as a means of reducing impacts from severe storm events.
  - **Performance measure:** Number of community personnel trained in ecological preservation and restoration practices.

### Resources, Leadership and Coordination:

- Evaluate and analyze incentive and policy alternatives that seek to encourage mitigation and safe growth strategies at all government levels, as well as among manufacturers, lending institutions, insurance companies, home builders and among individual homeowners.
- Identify and recommend innovative financial incentives that can be used by both the private sector and government to decrease costs and reduce risks.
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- Sea Grant, in collaboration with its partners, will develop a "Risk-Wise" educational program for local decision-makers to improve the safety and resiliency of communities threatened by coastal hazards.



- **Task:** Sea Grant scientists and specialists will serve in an advisory capacity on community planning and zoning commissions and boards to provide technical and educational expertise.
  - **Performance measure:** Number of community leaders and staff educated about hazard mitigation best practices related to social, economic, and environmental concerns.
- **Task:** Sea Grant and its partners will sponsor and convene a National Conference on Building Resilient Coastal Cities and Communities, which will include topics related to "resilient communities," "smart" growth, and "safe" growth principles for redevelopment and future development along the nation's coastlines.
  - **Performance measure:** Number of decision makers trained in hazard mitigation best practices.