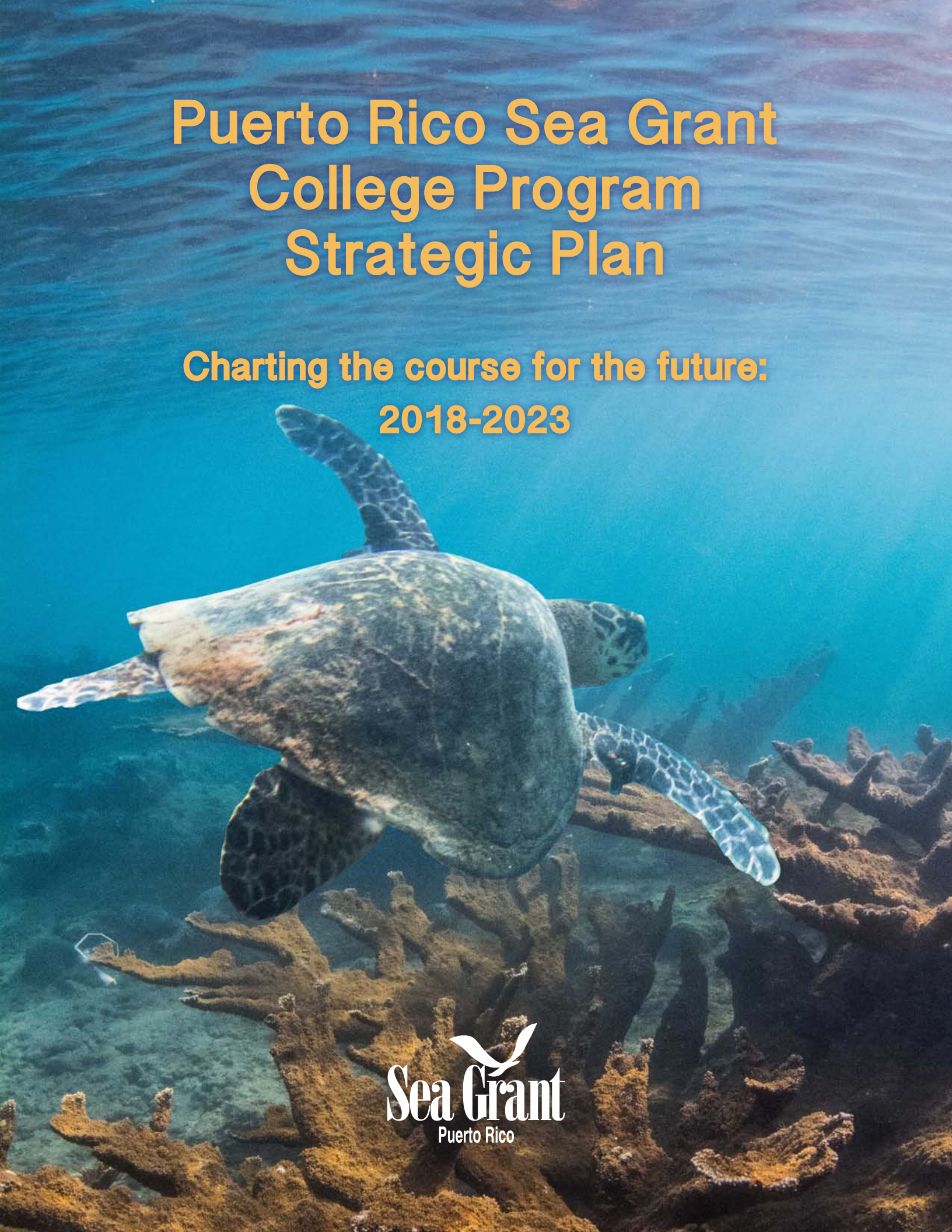
Puerto Rico Sea Grant College Program Strategic Plan

Charting the course for the future: 2018-2023



Sea Grant
Puerto Rico

Flamenco Beach, Culebra Puerto Rico.

Cover photo: Raúl Ortiz
Photo: Oliver Bencosme

Preface

This Puerto Rico Sea Grant Strategic Plan was nurtured by management and selected members of our staff, who provided guidance into its development. Information drawn from meetings, communications (electronic mail, letters, and position papers) and activities with our stakeholders (resource managers, fishers, extension agents, researchers, educators and coastal resource users) was used to prepare the plan. To guide the program into future areas of concern, we used information from focus groups, interviews, and a survey of resource users, managers, and scientists. A survey among members of the Advisory Council was conducted to finalize the process in 2020. This consultation process led to our extended 2018-2023 Strategic Plan, adapted to tend to the evolving needs based on the current socioeconomic, environmental, and recent earthquakes and coronavirus pandemic threats.

If there is a turning point that has influenced the way Puerto Rico Sea Grant develops and implements its educational, outreach and research efforts, it is the current COVID-19 pandemic. The coronavirus disease (Covid-19) crisis that erupted in 2020 requires simultaneous, decisive collective action in the environmental and socioeconomic fronts. Puerto Rico Sea Grant recognizes that inaction in the face of the pandemic has a serious cost and assumed the responsibility to contribute to the flattening of the curve of exponential growth to prevent health systems from being overwhelmed. We recognize that the health threat to our personnel is the primary threat to maintaining essential functions and services during the pandemic and in the socioeconomic front, to reduce the impact of the already sharp recession suffered by our archipelago, that erodes citizens' income. Through the virtual, continued, and uninterrupted delivery of the essential functions and services provided to our clientele of coastal and marine resources users, we have developed a viable continuity of operations plan employing strategies to mitigate specific threats posed by the pandemic. Our essential functions have been maintained through mitigation strategies that include social distancing protocols, increased hygiene, relocation of the organization's essential functions, telework and workforce flexibilities, limiting non-essential travel, suspension of non-essential activities, reduction of person to person contact with the clientele through implementation of systems and technologies that facilitate communication to perform essential functions. Our administration has identified systems and platforms that are needed to ensure that essential functions and contact with our clientele remain operational. Puerto Rico Sea Grant's infrastructure and support services provide for scale up remote meetings and working arrangements that allow our staff to securely access systems and through virtual connections and technologies including telephones, social media platforms, emails, Google Meet, Skype, GoToMeeting, Moodle open source learning platform and other electronic communication channels and platforms.

Vision

Puerto Rico Sea Grant envisions a future where people live in harmony with our coastal and marine resources while businesses and communities adapt to environmental and socioeconomic changes.

Our vision supports that articulated in the NSGCP: "The National Sea Grant Program envisions a future where people live, work, and play along our coasts in harmony with the natural resources that attract and sustain them. This is a vision of a coastal America where we use our natural resources in ways that capture the economic, environmental and cultural benefits they offer, while preserving their quality and abundance for future generations." As stated in NOAA's Strategic Plan, that vision requires healthy ecosystems, as well as resilient communities and economies "in the face of change."

This plan provides a broad foundation for economic growth and opportunity by focusing on key priorities established by the Department of Commerce specifically to equip our employees with the tools and knowledge needed to accomplish Puerto Rico Sea Grant's mission of protecting our environment and helping businesses and communities adapt to a changing planet.

Mission

Puerto Rico Sea Grant mission is to increase citizens' understanding and responsible use of Puerto Rico's and United States Virgin Islands' coastal and marine resources.

UPRSGCP's mission is based on the NSGCP's mission, "to provide integrated research, communication, education and extension and legal programs to coastal communities that lead to the responsible use of the nation's ocean, coastal, and Great Lakes resources through informed personal, policy, and management decisions.

The Environment in Which We Work

The coastal zone of the Archipelago of Puerto Rico and that of the United States Virgin Islands is its most critical natural resource. This archipelago is located at an active plate boundary between the North American plate and the northeast corner of the Caribbean plate. The archipelago's coastline includes near shore reefs, near shore islands, mangroves, wetlands, estuaries, tidal flats, sand dunes and the coastal land margin. Climate change affects coastal ecosystems directly and the extent of impact is increased by the cumulative effects of other threats including seasonal to decadal climate, geological and socioeconomic processes as well as pressures of the human population.

Our coastal zone is a finite resource and its capacity to withstand intensive use and development has reached a critical limit. The ecosystems contained in the coastal zone provide us with several different goods and services including tangible natural resources such as fisheries, for commercial and recreational use and less tangible services such as fish and crustacean recruitment in their marine habitats. Other less tangible services include the use of environmental amenities such as pristine beaches for recreational purposes, aquatic sports, tourism, and residential development.

During the last centuries, Puerto Rico established its critical infrastructure (buildings, ports, harbors, roads, power lines, sewage systems) in hazard-prone areas within the 1,075 kilometers of coastal zone. Besides, sixty one percent (61%) of the three point two (3.194) million citizens of Puerto Rico live within the forty-four (44) municipalities bordering the Atlantic Ocean and the Caribbean Sea. This route of inane coastal development augments the potential vulnerabilities associated with sea level rise, natural hazards, and shoreline erosion. Among the vulnerabilities and threats to Puerto Rico's coastal zone are

coastal saltwater intrusions, flooding, coral bleaching, inland migration of coastal ecosystems, changes to ocean chemistry and the increased frequency and intensity of tropical storms and earthquakes. These increased rates of climate and geological-related environmental changes have made the island's coastal communities vulnerable in ways never imagined. These increases are expected to have a series of socio-economic effects, including loss of land, infrastructure, jobs, and coastal resources, which implies a decline in economic, ecological, cultural and subsistence values associated with the coast. The long-term sustainability of Puerto Rico and its people is dependent on the coastal ecosystem's health. There is a need to develop strategies for the use and preservation of these resources, while assuring their economic and socio-cultural benefits.

For many decades Puerto Rico had an apparent vibrant, competent, and diverse economy that was the envy of most Caribbean and Latin American countries. Our main economic sectors consisted of the service sector (tourism, finance, real estate, and insurance) and the industrial sector (petrochemicals, electronics, pharmaceuticals, and textiles). However, in 2006 Congress eliminated Law 936 (which allowed tax breaks encouraging businesses to set up on the island), factories closed and job losses followed. To make matters worse, the 2008-2009 financial crisis and recession contracted the economy of Puerto Rico driving up unemployment to as high as 18.5%. Because of this economic scenario, thousands of Puerto Ricans have moved to the United States in search of jobs, and the island's population has decreased significantly, leaving the commonwealth with a lower tax base, affecting long-term economic growth. The island's population was an estimated 3.47 million in 2015, down 334,000 from 2000 – a 9% decline and is expected to fall to 2.98 million by 2050.

NOAA's Office of Coastal Management (OCM) which maintains the Economics: National Ocean Watch (ENOW) datasets states that, given their unique nature as islands, the USVI and Puerto Rico are more reliant on ocean-related activity than most U.S. states. The Bureau of Labor Statistics (BLS) reports 4,295 ocean-dependent establishments for Puerto Rico and an associated 66,720 employees and nearly $922 million in total wages for 2012, being the tourism and recreation sector responsible for the clear majority of ENOW defined economic activity. USVI's service producing industries account for 60% of the islands GDP, as much as 80% of these can be attributed to tourism-related activities.

Photo: Oliver Bencosme

Palomino Island, Puerto Rico.

Islands are uniquely vulnerable to many of the potential consequences of climate change, earthquakes, and tsunamis. Preliminary findings of our strategic planning process demonstrated challenges and suggested adjustments. This set our sight on the education of constituents to spur changes in behavior that would lead to conservation and sustainable development. As island communities, we need to become more resilient to geophysical, geological and a changing climate and consider implementing many adaptive strategies and design creative solutions, including public awareness and education, the enforcement of building codes, encouraging safer zoning and assisting public education for response to hazards. The University of Puerto Rico Sea Grant College Program (UPRSGCP) is qualified to respond swiftly to the stringent challenges faced by our coastal and marine resources. Sea Grant's integrated national network will be a key player in addressing these emerging issues. Our program will maintain its focus on the goals and objectives set forth in this plan and will consider the goals of the National Oceanic and Atmospheric Administration (NOAA), the National Sea Grant College Program (NSGCP) and those of the University of Puerto Rico.

The coastline of the Archipelago of Puerto Rico and the United States Virgin Islands is a rapidly changing, diverse and dynamic environment, vulnerable to many of the potential consequences of climate change. This coastline embodies: near shore reefs and islands, mangroves, wetlands, estuaries, tidal flats, sand dunes, and the coastal land margin. These coastal and marine ecosystems are connected to, and affected by, oceanic and seasonal to decadal climate processes and face a wide array of human induced stresses including: the impact of land and resource use, pollution, invasive species and the effects of climate variability and extreme weather events. The changes to our environment present our greatest opportunities and challenges. Sea Grant will continue to focus its resources to help coastal communities prepare for, respond to, and thrive in this changing environment by "*putting science to work for America's coastal communities*." These changes affect all our coastal communities, industries, and ecosystems. Shifts in land and resource use, weather events, climate variability and invasive species have created new demands for organizations and propelled the field in some completely new directions. However, we believe that these challenges also create numerous opportunities for the Puerto Rico Sea Grant College Program.

Ocean Economies of the USVI and PR

According to the document *Describing the Ocean Economies of the U.S. Virgin Islands and Puerto Rico*, NOAA's Office of Coastal Management (OCM) produces annual Economics: National Ocean Watch (ENOW) data for about 400 coastal counties in 30 coastal states. As stated in the document, "for each county and state, ENOW measures total establishments, employment, wages, and gross economic product (GDP) for each of the six ENOW economic sectors:

1. Living Resources
2. Marine Construction
3. Marine Transportation
4. Offshore Mineral Resources
5. Ship and Boat Building
6. Tourism and Recreation."

The document *Describing the Ocean Economies of the U.S. Virgin Islands and Puerto Rico* addresses those socioeconomic aspects that demonstrate how important the ocean is for the economy of these islands. Specifically it highlights several facts related to tourism and recreation, living resources (commercial and recreational fishing), and marine transportation that we are including to state the importance of coastal and marine resources in the economies of the Commonwealth of Puerto Rico and the territories of the U.S. Virgin Islands. Facts and information were extracted directly from the document and quoted as they were presented in the study. To read the complete document, please visit (https://coast.noaa.gov/digitalcoast/ training/econ-usvi-pr.html).

Tourism and Recreation - USVI

The USVI economy is much less diverse than the economy of Puerto Rico and is primarily driven by service-related industries that cater to more than 570,000 tourists and 2.1 million cruise ship passengers that visit the islands each year. Key economic sectors in the USVI include retail trade, public administration (i.e., government), and accommodation and food services. Manufacturing also contributes to the overall economy, particularly in terms of total wages. Based on our in-person meetings, most economic activity in the USVI is in some way linked to the ocean and, particularly, the tourism industry. (*Describing the Ocean Economics* 7)

- In 2012, the USVI's GDP amounted to $4.14 billion, about 0.02% of the GDP for the United States nation-wide. […] service-producing industries account for more than 60% of the islands' GDP, while goods-producing industries and government each account for approximately 20%. Several sources indicate that across these different sectors, as much as 80% of the USVI's GDP can be attributed to tourism-related activities. (*Describing the Ocean Economics* 7)

Photo: Oliver Bencosme

The Isleta de San Juan, Puerto Rico.

- […] in-person meetings and review of local data confirmed that in the USVI, most economic activity in the territory can in some way, directly or indirectly, be linked to the ocean. This is particularly true since the closing of the HOVENSA oil refinery on St. Croix in 2012, which had generated $1.5 billion annually in GDP for the territory, but was not directly dependent on the ocean. Tourism is the primary driver of local economic activity in the USVI, accounting for 60% to 80% of the islands' GDP. (*Describing the Ocean Economics* 21)

Living Resources (Commercial and Recreational Fishing) - USVI

- All commercial fishing operations must register and file a monthly Commercial Catch Report with USVI's Department of Planning and Natural Resources (DPNR), which DPNR in turn provides to NOAA Fisheries. These data, which we obtained from NOAA's Southeast Fisheries Science Center (SFSC), indicate that commercial fishermen caught close to 810,000 pounds of fish in 2014. The price per pound averaged between $5.00 to $6.00 for most species, with some high-value species (e.g., lobster) selling for more than $9.00 per pound (Kojis, 2014). SFSC reports that gross and net revenues for USVI fishermen in 2013 amounted to $4.26 and $2.48 million, respectively (Matt McPherson, NOAA SFSC, personal communication, January 22, 2016). (*Describing the Ocean Economics* 10)

Marine transportation - USVI

- Activities associated with the ENOW marine transportation, ship and boat building and repair, and living resources sectors also provide meaningful employment and generate economic activity throughout the territory. (*Describing the Ocean Economics* 21)

Tourism and Recreation – Puerto Rico

- According to the Puerto Rico Planning Board (PRPB), approximately 3.2 million people visited Puerto Rico in 2014 as tourists, and an additional 1.2 million people arrived via cruise ships (for perspective, the resident population of Puerto Rico is approximately 3.6 million). In that year, tourist and cruise-ship passenger expenditures amounted to $3.26 billion and $182 million, respectively. Tourists and cruise-ship passengers participate in a variety of activities in Puerto Rico, including boating, fishing, charter boating, snorkeling, surfing, kite sailing, beach lounging, shopping, visiting historical sites and nature parks, and more. Residents also enjoy many water-based activities, including surfing, boating, and fishing. (*Describing the Ocean Economics* 36-37)

- Other tourism-dependent sectors include car-rental agencies, taxis, some retail shops and bars, and businesses that organize thematic events, wedding services, and meetings for other destination-management corporations. In addition, tour operators (NAICS code 561520) are not included in ENOW; however, many establishments within this industry are likely ocean-dependent in Puerto Rico. (*Describing the Ocean Economics* 38)

Photo: Efra Figueroa

- In 2011, NOAA published The Economic Contribution of Marine Angler Expenditures in the United States, 2011 (Lovell et al., 2013). This study stated that total angler expenditures on marine recreational fishing in Puerto Rico amounted to $72 million in 2011.

- […] access and proximity to the beach are the most important features for visitors when booking a hotel, regardless of whether it has a casino on the premises. In general, visitors do not come to Puerto Rico to gamble but many stay at casino hotels. (*Describing the Ocean Economics* 39)

Living Resources (Commercial and Recreational Fishing) – Puerto Rico

- Most local catch is sold directly to residents, markets, and restaurants, as well as through fishing associations. According to personnel of Puerto Rico's Department of Natural and Environmental Resources, the average wholesale price per pound of fish and seafood is $3.00. In 2014, the Puerto Rican commercial fleet landed 2.3 million pounds of finfish and shellfish, generating more than $6.9 million in commercial wholesale value.[7] This in turn generated approximately $20.7 million in retail sales for local restaurants and seafood markets (together, approximately 0.05% of non-manufacturing GDP). It is important to note that although many fishermen sell to local restaurants and markets, the local catch accounts for only a small percentage of the seafood sold in these retail locations. Most restaurants and grocery stores and many seafood markets rely on imported fish because it provides them with a reliable, consistent, and less expensive source of supply. (*Describing the Ocean Economics* 28-29)

- There are no recent data on recreational fishing in Puerto Rico, but DNER personnel indicated that it is an important component of the tourism and recreation sector. The representatives we met with from DNER stated that there are approximately 100,000 recreational fishermen in Puerto Rico, fishing in both salt and fresh waters. Of these, only about 20 are recreational fishing charters dedicated to tourism. The overwhelming majority are residents fishing for their recreational pleasure. (*Describing the Ocean Economics* 38)

History and Overview

The National Sea Grant College Program was created by the U.S. Congress in 1966 to be a highly leveraged federal and state partnership to harness the intellectual capacity of the nation's universities and research institutions to solve problems and generate opportunities in our ocean, coastal, Great Lakes, and island regions and to build and enhance resilient communities. The National Sea Grant College Program engages citizens, communities, scientists, organizations, and governments to sustain and enhance the vitality, value, and wise use of the nation's coastal resources. Administered and supported by NOAA and matched by the state institutions, Sea Grant provides unique access to scientific expertise and to new discoveries through the 33 Sea Grant College Programs located throughout the nation. Sea Grant generates, translates, and delivers cutting-edge, unbiased, science-based information to address complex issues.

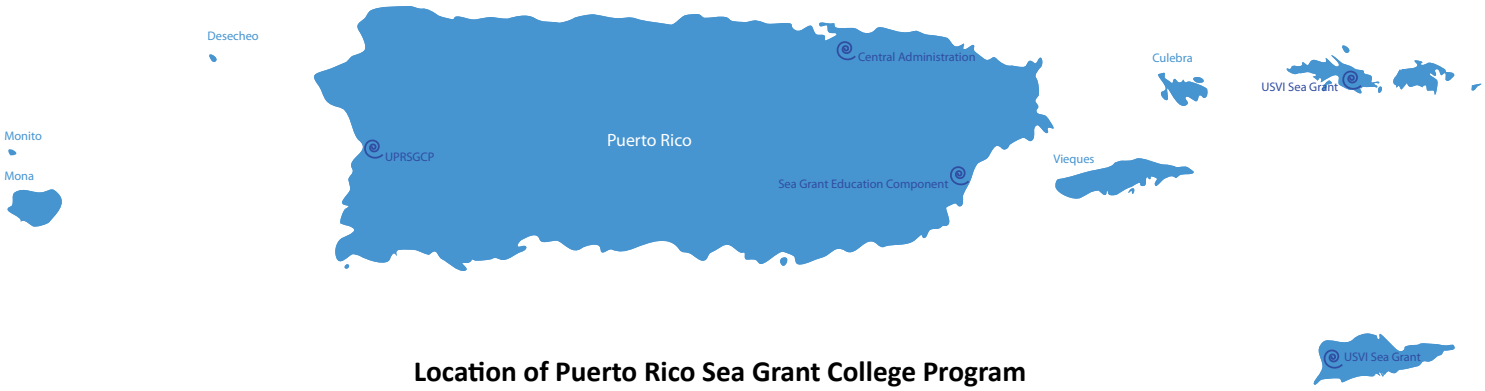
Sea Grant is a national network consisting of National Sea Grant Office, 33 Sea Grant College Programs, the National Sea Grant Advisory Board, the National Sea Grant Law Center, the National Sea Grant Library, and hundreds of participating institutions. The Sea Grant network enables NOAA and the nation to tap into the best science, technology, and expertise to balance human use and environmental concerns in coastal communities. Sea Grant's alliance with major research universities provides access to thousands of scientists, students, and outreach professionals. Sea Grant's College Programs are fundamental to the development of critically important professionals, such as scientists, educators, community leaders and resource managers, needed to research, inform and guide the responsible use and conservation of our nation's coastal resources. With its strong research capabilities, local knowledge, and on-the-ground workforce, Sea Grant provides an effective network (encompassing national, regional, state, and local levels) of unmatched ability to rapidly identify and capitalize on opportunities and to generate timely, practical solutions to real problems in real places.

Sea Grant serves America's communities along the coasts of the Atlantic, Pacific, Gulf of Mexico, Great Lakes, and the U.S. territories. To address issues that face coastal communities, Sea Grant provides the information, tools, and services to ensure coastal communities are sustainable. Sea Grant integrates its science and outreach programs regarding watersheds, coastal and ocean ecosystems and highlights the vital connections between these systems and the well-being of the Nation's coastal communities.

Sea Grant initiated its efforts in Puerto Rico with a Marine Advisory Project (SGMAP) established in the late 1970's at the University of Puerto Rico in Humacao. In 1980, the SGMAP was relocated as a comprehensive project to the University of Puerto Rico in Mayagüez and matured into a leading

La Selva Beach, Fajardo, Puerto Rico.

Photo: Oliver Bencosme



Location of Puerto Rico Sea Grant College Program

educational and conservational institution in Puerto Rico. The project evolved from an effort to educate primarily fishermen and seafood consumers into a diversified program that served mixed clientele groups of resource users, resource managers and policy makers. In 1981, in association with the University of the Virgin Islands, the UPRSGCP developed a Marine Advisory Project at the United States Virgin Islands as part of our effort to promote the sustainable development of coastal and marine resources in the Caribbean. In 1989, under the aegis of the Office of the President of the University of Puerto Rico, and the effort, vision and dedication of Dr. Manuel Hernández Avila, our program attained the status of Sea Grant College. With a wide range of public and private sector partners, our program has been able to provide integrated, applied research, outreach, and education projects. Since its inception, the UPRSGCP has been instrumental in solving problems and creating benefits and opportunities for coastal communities and marine resource users in the Caribbean region. Our program has responded to local environmental, geologic and socioeconomic challenges through the dissemination of science-based information as well as its non-regulatory presence in local communities. Sea Grant in Puerto Rico is considered an established ambassador, generating policy-relevant research, and spreading scientific and technological discoveries among resource managers, decision makers and the public.

The UPRSGCP Strategic Plan 2018-2023 incorporates the Department of Commerce, NOAA, the University of Puerto Rico and NSGO priorities and aligns them with our goals, strategies, outcomes, and performance measures. Our institutional culture and integrity, combined with a commitment to the Sea Grant core values, provide us the strength to achieve the goals set forth in this plan.

Photo: Alexis Rivera

Fisherman with cast net, Isabela, Puerto Rico.

Puerto Rico Sea Grant College Program Core Values

Puerto Rico Sea Grant College Program's core values are essential and enduring tenets that influence the organization and support its mission. The core values support a culture of integrity within a community that is known as an honest broker. The Puerto Rico Sea Grant College Program will be:

- Visionary - Advance innovative solutions that address emerging challenges (science and stewardship) and encourage creativity, initiative, and innovation.
- Collaborative – Seek partnerships that leverage our strengths. Be responsive and accessible, respect partners, maintain scientific neutrality, integrate diverse expertise, and provide the science and knowledge needed to inform stakeholders.
- Dedicated to Sustainability - Communicate the importance of good stewardship and the value of the services that the coastal, ocean, and Great Lakes' ecosystems provide to the Nation.
- Accountable - Operate with integrity and transparency; maintain quality and relevance in administration, management, and oversight.

Photo: Efra Figueroa

Puerto Rico Sea Grant College Program Cross-cutting Principles

Puerto Rico Sea Grant College Program will strive to address two specific areas that deserve the network's attention to enhance the Program's capabilities to meet its future needs. While implementing the 2018-2023 Strategic Plan, the Puerto Rico Sea Grant College Program will:

- **Cultivate Partnerships** by integrating the expertise and capabilities of partners from the international, federal, and state communities and from academia and nongovernmental organizations.
- **Enhance Diversity and Inclusion** by seeking and welcoming diverse perspectives and viewpoints to enhance cultural understanding and enable the network to pursue its vision and mission effectively and efficiently.

Planning Process and Strategic Approach

To manage Puerto Rico's and the U.S. Virgin Islands coastal and oceanic resources in ways that balance anthropogenic needs with environmental health, the island must progress in three fundamental areas:

- better information about how tropical coastal and oceanic ecosystems function, how anthropogenic activities affect tropical coastal and oceanic living resources and how we can adapt to environmental, socioeconomic, climate and geologic changes;

- citizens who understand the complexities of tropical coastal environments and the interactions between anthropogenic use and the health of coastal ecosystems;

- management and decision-making processes that are based on sound data and information, and involve everyone who benefits from the beauty of Puerto Rico's limited coastal resources, and include mechanisms to evaluate the trade-offs between anthropogenic and environmental needs.

Over the 2018-2023 period, UPR Sea Grant will concentrate its efforts in four areas: ***Healthy Ecosystems and Habitats (HEH)***; ***Resilient Communities and Economies (RCE)***, ***Education and Workforce Development (EWD) and*** **Sustainable Fisheries and Aquaculture (SFA)**.

These four interrelated focus areas emerged from the strategic planning process as areas of critical importance to the health and vitality of the Caribbean region's coastal resources and communities. They respond to issues of major importance to NOAA, the NSGCP, local decision–makers and resource users, and are topical areas in which Puerto Rico Sea Grant (PRSG) has made substantial contributions in the past and is positioned to make significant contributions in the future.

In each of the four focus areas, our program identified specific goals to pursue strategies designed to take advantage of its strengths in integrated research, outreach and education, and its respected, trustworthy and well-established presence in coastal communities of the region. Understanding relationships and synergies across focus areas is vital to achieving our goals. PRSG could not address these complex and interrelated issues without the collaboration of our public and private sector partners. Understanding how activities in one area support and complement other activities and using partnerships to accomplish shared goals are strategies inherent to PRSG, and will be central to achieving the goals outlined in this plan.

Photo: Raúl Ortiz

Focus Area: Healthy Ecosystems and Habitats

Puerto Rico and the United States Virgin Islands (USVI) share common problems related to the sustainable development of their natural resources and attractions. Some of the typical problems of this archipelago include: resource degradation related to natural hazards (hurricanes, earthquakes, tsunamis, landslides, and flooding), climate change (sea level rise, rising air and sea temperatures, severe weather events and changing rainfall patterns) and to human induced factors (deforestation, habitat destruction, over-fishing, extinction of species, modification of the maritime zone, coastal water quality degradation). Several socio-economic (political status, economic dependence, incompetent or corrupt politicians), biological, physical, and geographic factors also limit the sustainable development of the natural resources of these island countries.

Puerto Rico's sea and its coastline constitute a vital environment in which a broad and complex variety of urban dwellers, resource users, and tourists all compete for its recreational and economic resources. Our coastlines are changing under pressure from urban development, toxic contamination of sediments and species, sea level rise and overharvest of resources. The present and future growth of both the real estate business and the construction industry lies in the coastal plains. However rising sea levels are causing landward migration of beaches due to the combined effects of inundation and shoreline erosion. Rising sea levels are expected to increase the movement of salt water into freshwater wetlands, affect the balance of coastal erosion and sediment build-up as well as tidal connections between sea and land. Altered rain patterns and flooding combined with human land use can lead to poor water quality by accumulating nutrients, soil and pollutants that end up in estuaries and coastal waters. Precipitation patterns together with sea level rise change the dynamics of erosion and deposition processes and alter sediment availability. Organisms that live in coastal and estuarine ecosystems have adapted to cope with occasional environment disturbances however, severe weather events can disrupt the normal cycle of variability to which animals and plants have adapted. Small islands can be affected by rising sea levels that inundate low-lying coastal areas affecting critical habitat for several species particularly marine turtles and seabirds. Sea level rise is also causing problems for plants and animals inundating breeding and nesting sites. Rising sea level is also pushing saltwater through the ground, injecting seawater to and degrading fresh ground water sources.

Resource management and conservation in coastal waters must address a varied list of impacts from human activities. Anthropogenic impacts have increased along with our rapid population growth, changes in land use and substantial developments in technology. The nutrient runoff from upstream farms that flows down the rivers, are responsible for many of our tainted inshore waters causing higher algal growth, build-up of pollutants in sediments and marine species, and reduced light and smothered corals. Our coastal waters have long been used as an intentional dumping ground for all sorts of waste including sewage, chemicals and industrial run-off especially areas close to river mouths which are most exposed to increased sediments, nutrients and pesticides. All this marine pollution is seriously damaging marine habitats and living organisms through bioaccumulation. Eutrophication caused by the release of excess nutrients into coastal areas via streams and rivers, results in the death by oxygen starvation of large numbers of organisms including fish. Coastal residents have always used the ocean as a source of food causing fish stocks on our continental shelf areas to be practically over exploited. Introduced species also present a threat to our marine ecosystems and once established it is very difficult or impossible to remove (lionfish).

Anthropogenic activities have caused the amount of carbon dioxide in our atmosphere to rise dramatically. Reef-building corals are highly vulnerable to ocean acidification and rising sea temperatures. Slowed growth and loss of hard corals has reduced essential fish habitat for many reef organisms. The impact on the marine environment of carbon dioxide absorption has resulted in the seawater becoming more acidic slowing the rate of skeleton formation of hard corals and many other organisms that contribute to reef building, such as coralline algae. Persisting ocean acidification will ultimately contribute to coral loss, and a weakening and collapse of limestone reef structures and coral loss and endangering their function as barriers, protecting inshore habitats and human communities from large waves and storm surges. Many plankton species depend on propitious ocean chemistry to build calcium carbonate shells, skeletons and plates and ocean acidification

will make it more difficult to build these structures. It will also affect the pelagic eggs and larval stages of various fish and other marine organisms. Higher than normal sea temperatures are causing hard corals to bleach more often and with greater severity, reducing the abundance of living coral reefs and its three dimensional structure, that provides shelter and refuge for many animals that rely on the reef for their habitat.

A flurry of hundreds of small earthquakes topped by a 6.4 temblor that killed one person, damaged hundreds of buildings, knocked out of power the entire island, left without water service many of the residents living along the southern coastline and caused close to 5,000 people to seek refuge in government shelters. While many Puerto Ricans were surprised, scientists and the PRSGCP have been informing and alerting communities and government officials of the physical threat but no action was taken. More than 2,000 earthquakes have hit Puerto Rico's southern region since December 28, 2019 with more than 4 of them magnitude 4.5 or greater. These facts are extremely worrisome since close to 200,000 homes across Puerto Rico are not build to code, as evidence by the damage caused in recent days to schools, bridges, homes and island infrastructure. Professor Ben van der Plujim from the University of Michigan states that "*The seismic activity is related to an active deformation zone near the northern boundary of the Caribbean microplate, which is wedge between the North American and the South American tectonic plates. Historic earthquakes along the zone result from a mixture of normal reverse and lateral slip faulting as tectonic plates jostle. Societal impacts in the region are amplified because the infrastructure is not well prepared to strong shaking from shallow earthquakes*."

These growing social, economic, geologic, and environmental pressures will increase the demands placed on our coastal resources and threaten the health of these coastal ecosystems, which are the foundation for life along the coast. The UPRSGCP aims to improve and enhance abilities, economic strategies, and planning efforts of coastal communities, insular and federal government agencies, industry, university, and small entrepreneurs in their interaction with marine resources. UPRSGCP's regional consortia, nationwide networks, and international contacts are particularly well suited for helping the nation address ecosystem health at the appropriate local, state, regional, national and global levels.

- GOAL: Habitat, ecosystems, and the services they provide are protected, enhanced, and/or restored.
    - ACTION: Develop and share scientific understanding, decision-support tools, technologies, and approaches to protect and restore ecosystems through the implementation of face to face communication, publications and the expansion of a range of integrated web based applications to enhance and provide access to our education, communication and extension services and products.
        - DESIRED OUTCOME: Scientific understanding and technological solutions inform and improve conservation and the management of natural resources.
        - DESIRED OUTCOME: Ecosystem science and conservation priorities developed are addressed through stakeholder participation.
        - DESIRED OUTCOME: Greater awareness and understanding of ecosystem functions and the services they provide improves stewardship efforts.
    - ACTION: Promote the sustainability of the habitat, the biodiversity, and the abundance of coastal ecosystems, fish, wildlife, and plants through face to face communication and a range of integrated web based applications that provide information, tools and resources to support and enhance the delivery of wise use and sustainability practices.
        - DESIRED OUTCOME: Declining biodiversity, habitats, and ecosystem functions and services are restored and sustained.
        - DESIRED OUTCOME: Improved collaborative planning and decision-making leads to enhanced stewardship.

Tres Palmas Marine Reserve, Rincón, Puerto Rico

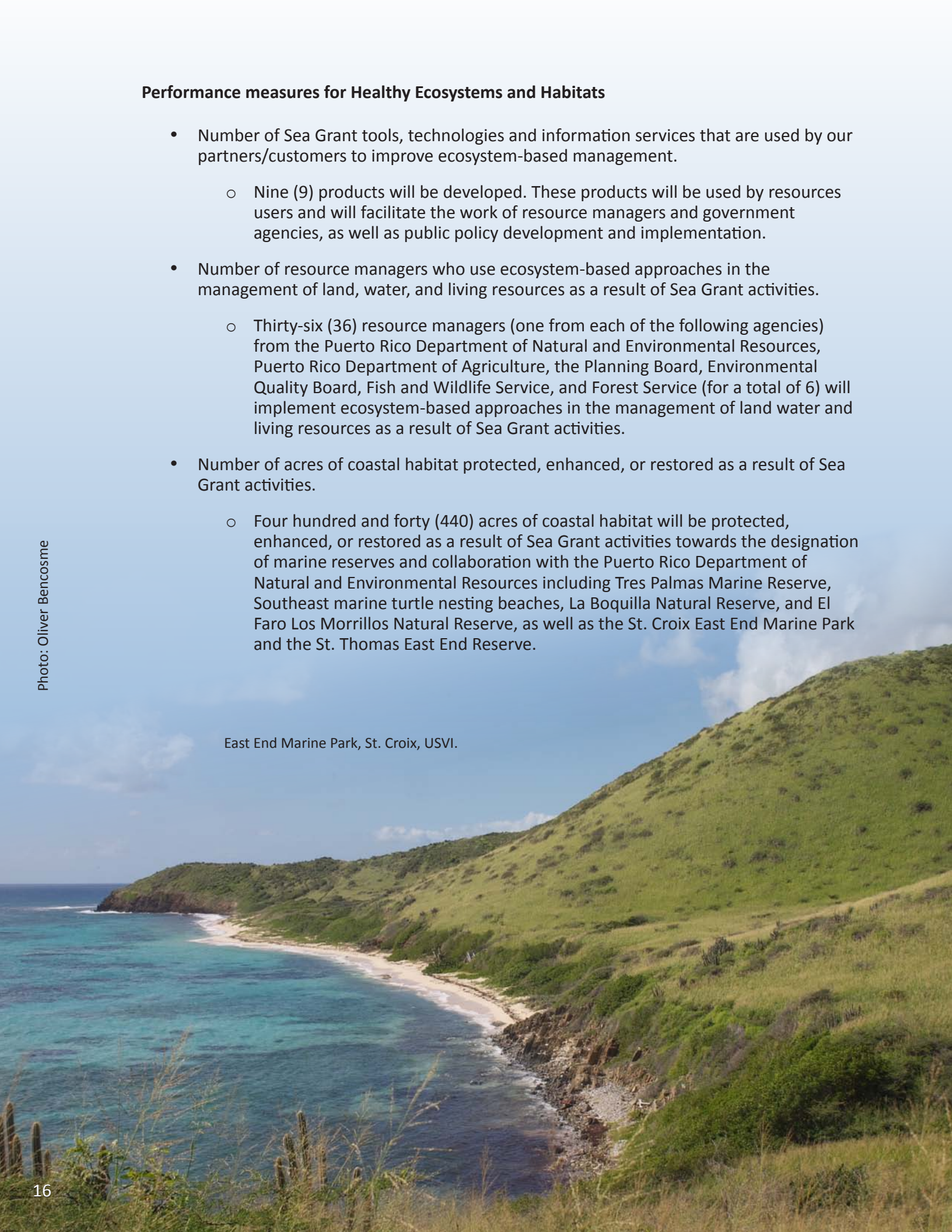
Photo: Oliver Bencosme

- GOAL: Land, water, and living resources are managed by applying sound science, tools, and services to sustain ecosystems.
    - ACTION: Support a sound science- and management-driven framework that integrates observations, monitoring, research, and modeling to provide a scientific basis for informed decision-making through face to face communication and a range of integrated web based applications that provide information, tools and resources to support and enhance observations, monitoring, research, and modeling in order to provide a scientific basis for informed decision-making.
        - DESIRED OUTCOME: Collaborations with partners and stakeholders support planning, research and technological solutions to address resource management needs.
        - DESIRED OUTCOME: Citizen science initiatives are engaged and contribute to improving our knowledge with respect to coastal communities and ecosystems.
        - DESIRED OUTCOME: Communities have access to sound science, data, tools, and the training to be effective in planning and decision-making processes.
        - DESIRED OUTCOME: Resource managers understand the risks, the options, tradeoffs, and impacts of their decisions.
    - ACTION: Identify and promote case studies and strategies that enhance resilient ecosystems and watersheds in the context of changing conditions through face to face communication, publications and a range of integrated web based applications that provide information, tools and resources to support and enhance observations, monitoring, research, and modeling to provide a scientific basis for informed decision-making.
        - DESIRED OUTCOME: Communities have access to information and understand projected changes within coastal ecosystems and how changes will impact coastal ecosystems.
        - DESIRED OUTCOME: Communities can access case studies, training and tools to improve their ability to plan, prepare and adapt to future ecosystem conditions.

Performance measures for Healthy Ecosystems and Habitats

- Number of Sea Grant tools, technologies and information services that are used by our partners/customers to improve ecosystem-based management.
    - Nine (9) products will be developed. These products will be used by resources users and will facilitate the work of resource managers and government agencies, as well as public policy development and implementation.
- Number of resource managers who use ecosystem-based approaches in the management of land, water, and living resources as a result of Sea Grant activities.
    - Thirty-six (36) resource managers (one from each of the following agencies) from the Puerto Rico Department of Natural and Environmental Resources, Puerto Rico Department of Agriculture, the Planning Board, Environmental Quality Board, Fish and Wildlife Service, and Forest Service (for a total of 6) will implement ecosystem-based approaches in the management of land water and living resources as a result of Sea Grant activities.
- Number of acres of coastal habitat protected, enhanced, or restored as a result of Sea Grant activities.
    - Four hundred and forty (440) acres of coastal habitat will be protected, enhanced, or restored as a result of Sea Grant activities towards the designation of marine reserves and collaboration with the Puerto Rico Department of Natural and Environmental Resources including Tres Palmas Marine Reserve, Southeast marine turtle nesting beaches, La Boquilla Natural Reserve, and El Faro Los Morrillos Natural Reserve, as well as the St. Croix East End Marine Park and the St. Thomas East End Reserve.

Photo: Oliver Bencosme



East End Marine Park, St. Croix, USVI.

Photo: Efra Figueroa

Focus Area: Sustainable Fisheries and Aquaculture

Fisheries

The United States Virgin Islands (USVI) and Puerto Rico's oceanic and benthic habitats and biodiversity, are tropical insular systems, characterized by oligotrophic waters that lack the abundance and biomass to sustain a large fishing endeavor. The fisheries of Puerto Rico are characteristically small-scale in nature, comprised of owner-operators who utilize small vessels with limited horsepower and who land low quantities on average, of a variety of species (Griffiths and Valdés-Pizzini 2002). Since 1987, Puerto Rico's reported landings of fish and shellfish have continued to be near 2-3 million pounds (Daniel Matos Caraballo 2012). In 2014, the Puerto Rican commercial fleet landed 2.3 million pounds of finfish and shellfish, generating more than $6.9 million in commercial wholesale value (Abt Associates Inc. 2016). This economically important, small-scale commercial fishery consists of close to 1,200 artisanal fishermen that utilize diverse gear types along the island's four coastlines.

Our fisheries are threatened by anthropogenic impacts, such as: sedimentation of coral reefs, urban growth, development of construction projects, changes in land use patterns, destruction of mangrove forests and seagrass beds, construction of dams, tourism and recreational activities, agricultural activities, industrialization, contamination of estuaries and coastal waters with toxic substances, removal of wetlands, introduction of non-indigenous species, military activities and the accumulating impacts of global warming. In addition, management measures are based on incomplete information on the level of direct extraction of fish since recreational fishers are not formally accounted for nor are required to report their catch. Fishing in Puerto Rico is currently in a delicate state, and the solution to its problems is a difficult one (Valdes-Pizzini, 2011).

Acuaculture harvesting

Photo: Ruperto Chaparro

Aquaculture

Puerto Rico Sea Grant aquaculture efforts will give special emphasis to the 10 Year NOAA Sea Grant Aquaculture Vision of March 2016. Our program will nurture existing partnerships among academia, the industry, and federal and state programs to expand aquaculture production, increase profitability and complement our traditional fisheries. Special attention will be given to the five Sea Grant Aquaculture Focus Areas with emphasis in small-scale projects that promote family food security: 1) Commerce; 2) Permitting and Policies; 3) Current and Emerging Species; 4) Production Systems; and 5) Seafood Safety and Quality. These efforts are expected to lead to a vibrant aquaculture industry in Puerto Rico and the USVI.

- GOAL: Fisheries, aquaculture, and other coastal and freshwater product industries supply food, jobs, and economic and cultural benefits.
    - ACTION: Develop a trained workforce and enhance technology transfer in domestic aquaculture through face to face communication, publications, partnerships, collaborations and a range of integrated web based applications that provide information, tools and resources to support and enhance food supply, jobs and economic and cultural benefits.
        - DESIRED OUTCOME: Increased understanding and technological solutions aid aquaculture management and production.
        - DESIRED OUTCOME: Partnerships enable the aquaculture industry to adapt and acquire innovative technologies.
    - ACTION: Promote and support harvest and processing techniques that lead to safe, sustainable and high-quality food and economic and ecosystem benefits through face to

face communication, publications, partnerships, collaborations and a range of integrated web based applications that provide information, tools and resources to support and enhance fisheries and aquaculture products and industries.

- DESIRED OUTCOME: Coastal resource industries employ technologies and reinforce strategies to ensure safe and sustainable seafood and products.
- DESIRED OUTCOME: Consumers understand the health benefits of seafood and purchase safe and sustainable products.
- DESIRED OUTCOME: Coastal resource industries employ strategies that balance economic, community and conservation goals.

- GOAL: Natural resources are sustained to support fishing communities and industries, including commercial, recreational, and subsistence fisheries, and aquaculture.

  - ACTION: Ensure sound science, services, and tools are available and accessible to resource managers, the fishing and aquaculture communities and consumers through face to face communication, publications, partnerships, collaborations and a range of integrated web based applications that provide information, tools and resources to support and enhance sustainable fishing communities and industries, including commercial, recreational, and subsistence fisheries, and aquaculture.

    - DESIRED OUTCOME: Commercial and recreational fishermen and aquaculturists are knowledgeable about efficient, sustainable, and responsible tools, techniques, and uses of coastal and freshwater resources.
    - DESIRED OUTCOME: Innovative solutions that increase understanding of climate impacts on fisheries and aquaculture are available and accessible to resource managers and fishing and aquaculture communities.
    - DESIRED OUTCOME: Resource managers and fishing and aquaculture communities have access to science and tools to increase their capability to adapt to future resource management needs.

Performance measures for Sustainable Fisheries and Aquaculture

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

  - Two hundred (200) recreational fishermen, aquaculturists, and restaurant owners will modify their practices as a result of the knowledge gained through Sea Grant activities.

- Economic and societal impacts derived from Sea Grant activities.

  - Four (4) businesses and four (4) jobs will be sustained as a result of collaboration and participation in Sea Grant efforts.

  - Sea Grant activities will contribute to maintain the total economic benefit from commercial fisheries to society of close to $48,000,000.

- Number of Sea Grant tools, technologies and information services that are used by our partners/customers to improve ecosystem-based management.

  - Three (3) products will be developed and used to improve the practices of commercial and recreational fishermen and aquaculturists.

Photo: Raúl Ortíz

Focus Area: Resilient Communities and Economies

Coastal communities, ecosystems, resources and natural attractions in Puerto Rico and the USVI, provide vital economic, social, and recreational opportunities for millions of residents, but decades of population migration have transformed our coastal landscapes and intensified demand on finite coastal resources. The increase in population has resulted in new housing developments and recreation facilities, as well as a new generation of energy development activities, port expansions, and other business activities. As stated in a recent economic NOAA report from the Office of Coastal Management "Representatives from both the Puerto Rico Hotel and Tourism Association and the Puerto Rico Tourism Company " access and proximity to the beach are the most important features for visitors when booking a hotel, regardless of whether it has a casino on the premises. In general, visitors do not come to Puerto Rico to gamble." After in-person-meetings and review of local data the report confirms that much of the economic activity in Puerto Rico is linked to the ocean.

Following a national demographic trend, more and more of the Puerto Rican population is moving into coastal areas each year, creating a demand for housing and development that causes erosion, reduces water quality, curtails access to the beach and eradicate mangrove and wetland habitats. According to the Puerto Rico Planning Board, close to 3.2 million people visited Puerto Rico in 2014 as tourists, and an additional 1.2 million people arrived via cruise ships. Expenditures from these visitors amounted to $3.26 billion and $182 million, respectively. As indicated by NOAA's Office of Coastal Management, tourists in general enjoyed a variety of activities during their visit, including fishing, snorkeling, charter boating, boating, surfing, beach lunging, sites and nature parks, visiting historical sites among others. Residents are also users of these water-based activities, which make up approximately 2% of the $2.43 billion GDP. When indirect and induced effects are considered, the travel and tourism sector contributed $7.42 billion to the Puerto Rico economy, approximately 7.3% of the GDP for 2014.

These changes are placing tremendous pressure on coastal lands, water supplies and traditional ways of life. To accommodate more people and activities and 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 oceanic resources. UPRSGCP will engage a diverse and growing coastal population by applying the best available scientific knowledge, and use its extension and education capabilities to support the development of healthy coastal communities that are economically and socially inclusive, supported by diverse and vibrant economies and function within the carrying capacity of their ecosystems.

All the residents of Puerto Rico and the USVI are considered coastal residents since they live less than fifty miles from the coast. New developments and critical infrastructure for tourism, industries and commerce are established in the coastal zone, which are the most rapidly growing areas in the territories. Citizens and decision-makers have an urgent need for tools that will help them evaluate the implications of land-use changes, coastal development pressures, and increased resource use, in approaching the policy and management decisions they face. Regional cooperation and coordinated land-use and watershed planning are essential. UPRSGCP's well-established role as a trusted broker among a wide range of interests, makes it a key player in providing sound information for decision-makers, convening stakeholders to seek common ground, and facilitating the development and implementation of new coastal policies, plans, management approaches, and consensus-building strategies.

The sea level rise, increased number and intensity of coastal storms and other natural and human hazards are putting more people and property at risk along the nation's coasts with major implications for human safety and the economic and environmental health of coastal areas. It is essential that residents of coastal communities understand these risks and learn what they can do to reduce their vulnerability and respond quickly and effectively when these events occur. UPRSGCP will use its integrated research, training, technical assistance capabilities and its presence in coastal communities to play a major role in helping local citizens, decision-makers, and industries plan for hazardous events and optimize the ability of their communities to respond and rebuild.

Photo: Oliver Bencosme

It is not enough for communities and businesses to understand their vulnerabilities; they must act on this knowledge and become more resilient or the human and economic losses will continue to mount. Individuals, businesses, and communities need to develop comprehensive emergency preparedness and response plans that increase their resiliency and enable them to respond effectively. Sea Grant will contribute to this by building a sound knowledge base to improve forecasting capabilities by identifying development and best management practices that reduce the vulnerability of people, buildings and businesses to coastal hazards, and by advancing ways in which communities can manage, and recover from these events when they occur.

- GOAL: Coastal communities use their knowledge of changing conditions and risks to become resilient to extreme events, economic disruptions, and other threats to community well-being.
    - ACTION: Use innovative tools including face to face communication, publications, partnerships, collaborations, webinars, and a range of integrated web based applications that provide information, tools and resources to increase the public's awareness of changing conditions and the potential impacts their communities and economies may encounter.
        - DESIRED OUTCOME: Members of the community, including the underserved, are aware of and understand changing conditions and hazards and the implications to their communities, and are prepared to respond, and adapt.
        - DESIRED OUTCOME: Existing and innovative training programs improve community leaders' understanding of changing conditions in their communities and implement adaptive strategies.
    - ACTION: Provide access to innovative tools including face to face communication, publications, partnerships, collaborations, webinars, and a range of integrated web based applications that provide information, tools and resources to support and enhance comprehensive planning and adaptive management strategies to enhance community resilience and adapt to hazards and changing environmental and socioeconomic conditions.
        - DESIRED OUTCOME: Communities have access to information needed to understand the factors impacting ecosystems and participate in adaptive management planning.
        - DESIRED OUTCOME: Communities employ adaptive management strategies and apply tools to engage diverse members of the community to improve resilience and community sustainability.
    - ACTION: Provide access to innovative tools including face to face communication, publications, partnerships, collaborations, webinars, and a range of integrated web

Swell event in Combate, Cabo Rojo, Puerto Rico

based applications that provide information, tools and resources to support and enhance increase the resilience of coastal communities through diversification, growth, and strengthening of coastal economic sectors.

- DESIRED OUTCOME: Members of the community, including the underserved, have access to information needed to understand how coastal economic activities and trends will impact environmental and community well-being.
- DESIRED OUTCOME: Communities have access to tools, services, and technologies to adapt and grow resilient economies.
- DESIRED OUTCOME: Leaders in coastal economic sectors understand how they can become more resilient through diversification and through conservation of ecosystem services.

- GOAL: Water resources are sustained and protected to meet existing and emerging needs of the communities, economies, and ecosystems that depend on them.
  - ACTION: Inform community members through face to face communication, publications, partnerships, collaborations, webinars, and a range of integrated web based applications that provide information, tools and resources about how actions impact water quality and availability.
    - DESIRED OUTCOME: Community members understand watershed functions and the services they provide that support communities and economies.
    - DESIRED OUTCOME: Community members understand how actions will impact water quality and quantity and are able to make informed decisions.
  - ACTION: Collaborate with stakeholders to develop and share through face to face communication, publications, partnerships, collaborations, webinars, and a range of integrated web based applications that provide information, tools and resources about best management practices (BMPs) and measures to protect and manage water resources.
    - DESIRED OUTCOME: Communities have access to sound science, data, tools, and services to understand and anticipate changes in water quality and quantity.
    - DESIRED OUTCOME: Communities have diverse, sustainable economies and industries that support the existing and emerging water resource needs.
    - DESIRED OUTCOME: Communities have access to science, tools, and technologies to protect and sustain water resources and make informed decisions.

La Ventana al Mar, San Juan, Puerto Rico

Photo: Oliver Bencosme

Performance measures for Resilient Communities and Economies

- Number of communities that adopt/implement sustainable economic and environmental development practices and policies as a result of Sea Grant activities.
    - Forty-five (45) communities will have access to sound science, data, tools, and services to protect and sustain water resources, and to improve their decision-making regarding changes in water quality, watershed functions, and water resource needs.
- Number of communities that adopt/implement hazard resiliency practices to prepare for and respond to/minimize coastal hazardous events as a result of Sea Grant activities.
    - Nine (9) communities will receive training and information to enable their adaptation to changing conditions in their communities and improve their strategies to become more resilient to natural hazards.

Focus Area: Environmental Literacy and Workforce Development

UPR Sea Grant has been a leader in the transfer of information and technology and a major force in capacity building for NGOs, resource managers and teachers. Since the beginning of our program in the late 1970's, marine education through formal and informal means, and the building of ocean literacy has been our forte. We believe that education is critical for a better citizenship, for the stewardship of the resources and the conservation of ecosystems and habitats, and for the building of sustainable practices in our archipelago. As stated in the NSGCP Strategic Plan, the future workforce, and successful communities facing natural and socio-economic changes need to be literate in science, technology, engineering and mathematics (STEM) to be competitive, but also to be resilient and face the challenges imposed by unsustainable practices and policies. Our stakeholders and communities, in PR/USVI face everyday development projects and policies that jeopardize their livelihoods and threaten the health of the ecosystems and habitats. It is our mission to provide them with the best information available, and to share with them the knowledge and tools for sustainability. It is our goal to build an ocean, and coastal ecosystems and habitats literacy for action.

- GOAL: An environmentally literate public that is informed by lifelong formal and informal opportunities that reflect the range of diversity of our communities.
    - ACTION: Enable the public to engage in community planning by providing scientific information and learning experiences through face to face communication and access to learning platforms, publications, partnerships, collaborations, webinars, and a range of integrated web based applications that provide information, tools and resources with respect to adaptive management to climate change and resilience to extreme natural events.
        - DESIRED OUTCOME: Communities are knowledgeable and equipped with the best available science and technology to contribute to adaptive management planning processes and stewardship.
    - ACTION: Increase effective environmental literacy instruction for K-12 students by formal and informal educators through face to face communication and access to learning platforms, publications, partnerships, collaborations, webinars, and a range of integrated web based applications.
        - DESIRED OUTCOME: Teachers and students are better informed in science, technology, engineering, and mathematics fields and can employ their knowledge to support sustainable practices within their communities.

        - DESIRED OUTCOME: Expand the utilization of marine education materials developed by Sea Grant/NOAA among local teachers by integrating it into their curricula and programs.

    - ACTION: Utilize traditional face to face communication and access to learning platforms, publications, partnerships, collaborations, webinars, and a range of integrated web based applications increase effective environmental literacy communication to stakeholders, including how ecosystem change affects economic, social, and cultural values, as well as implications for conservation and management.

        - DESIRED OUTCOME: Stakeholders develop a sense of awareness, understanding and stewardship to sustain watershed, coastal, and marine ecosystems and resources.
        - DESIRED OUTCOME: Communities implement sustainable strategies when managing natural resources and make decisions based on information acquired through informal science education.

- GOAL: A diverse and skilled workforce is engaged and enabled to address critical local, regional, and national needs.

    - ACTION: Grow awareness among the nation's diverse population of career paths that support the needs of the nation's coastal communities through face to face communication and access to learning platforms, publications, partnerships, collaborations, webinars, and a range of integrated web based applications.

        - DESIRED OUTCOME: All members of a community are enabled to explore and pursue the variety of occupations that are essential to sustain the nation's coastal communities and ecosystems.

    - ACTION: Increase opportunities for undergraduate and graduate students to gain knowledge and experience in the science and management of watershed, coastal, and marine resources through face to face communication and access to learning platforms, publications, partnerships, collaborations, webinars, and a range of integrated web based applications.

        - DESIRED OUTCOME: College level courses and internships provide increased literacy, experience, and preparedness in areas of watershed, coastal, and marine ecosystems for all students particularly those from underrepresented groups.
        - DESIRED OUTCOME: Undergraduate and graduate students particularly those from underrepresented groups, are supported and have access to formal and experiential learning, training, and research experiences.

    - ACTION: Prepare through face to face communication and access to learning platforms, publications, partnerships, collaborations, webinars, and a range of integrated web based applications a responsive and diverse workforce to advance and benefit from sectors that support the needs of the nation's coastal communities and ecosystems (e.g. industry, research, government, etc.), and to adapt and thrive in changing conditions.

        - DESIRED OUTCOME: Employment in all sectors of the U.S. coastal resource enterprise expands and diversifies.
        - DESIRED OUTCOME: The existing and future workforce can adapt and thrive in changing environmental, social, and economic conditions.

Photo: Oliver Bencosme

Performance measures for Environmental Literacy and Workforce Development

- Number of people engaged in Sea Grant-supported informal education programs.
    - Eleven thousand (11,000) individuals will be reached and will become actively engaged in Sea Grant-supported informal education programs including Sandwatch, activities offered to members of the 4H Clubs coordinated with the Agricultural Extension Service, groups attending our climate change education center (CenECCA) and efforts in the Tres Palmas Marine Reserve with the organization Amigos de Tres Palmas.
    - Three hundred (300) individuals will participate in workshops, training, and other activities via face to face and distance learning.
- Number of Sea Grant-supported graduates who become employed in a job related to their degree within two years of graduation.
    - Five students supported by Sea Grant through research funding or professional development opportunities will become employed in a degree-related field within two years of graduation.
- Number of Sea Grant products that are used to advance environmental literacy and workforce development
    - Twenty (20) products will be used to advance environmental literacy in all sectors of the community and develop a workforce prepared to enhance the coastal resource enterprise while sustainably responding to environmental changes.


Photo: Oliver Bencosme
Sea Grant
Puerto Rico