

PIER 2018 Annual Report

Puerto Rico Sea Grant

Official Level of Effort - Only Approved Funding

Report Generated by YULISSA GARCIA on 12/13/2021

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2018 Level of Effort

National Focus Area Name	SG Federal	Match	Pass Thru	Federal+ Match + Pass Thru	LOE without Leverage (%)	Leveraged (Managed)	LOE with Leverage (%)
Healthy Coastal Ecosystems	\$405,840	\$219,312	\$0	\$625,152	33 %	\$21,244	33 %
Sustainable Fisheries and Aquaculture	\$252,603	\$151,255	\$0	\$403,858	21 %	\$21,244	22 %
Resilient Communities and Economies	\$304,333	\$151,255	\$3,500	\$459,088	24 %	\$21,244	24 %
Environmental Literacy and Workforce Development	\$252,603	\$151,255	\$0	\$403,858	21 %	\$21,244	22 %
TOTAL ALL FOCUS AREAS:	\$1,215,379	\$673,077	\$3,500	\$1,891,956	100 %	\$84,976	100 %

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2018 Impacts & Accomplishments

Puerto Rico Sea Grant Efforts Contributed to the Expansion of Protected Wetland System

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Impact
- Approved

RECAP: During the last decades, Puerto Rico suffered the loss of hundreds of acres of wetlands and mangroves, primarily by urban development and unplanned infrastructure. The Environmental Protection Agency estimated, in 2004, that PR lost 50% of the mangroves that had for a 100 year.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

Relevance: The "Caño Boquilla" Wetland System (CBWS) was established in 2002 to protect approximately 120 acres of public domain coastal lands that include the maritime zone, wetland forests, estuaries, beaches, and 9 nautical miles of maritime jurisdiction at the Mayaguez-Añasco Bay, in the western Puerto Rico. This coastal ecosystem is part of the Río Grande de Añasco Watershed, an important source of fresh water for the people of the region.

Response: Puerto Rico Sea Grant specialist and the local NGO have been in place, since 2006, an initiative to enhance and increase the CBWS land extension and protection practices. After years of collaboration, the DNER, in alliance with the NGO Mayaguezanos Por la Salud y el Ambiente, added new 16.7 acres of wetlands and riverine ecosystems to the CBWS during this year (2018), increasing from originally 120 acres (2002) to 193 acres of wetland system, up today (2018).

Results: Actually, the CBWS increases its land extension to 193 acres of wetlands and mangroves, with an economic investment that exceeds \$450,000. This effort helped to recover and protect wetland habitats for the people of Puerto Rico, reversing the tendency of this habitat loss in the last decades. Puerto Rico Sea Grant and partners will continue outreach efforts through competitive proposals preparation and publications posted on the reserve's web page. (granreservaboquilla.wordpress.com)

PARTNERS: Puerto Rico Department of Natural and Environmental Resources; Mayaguezanos Por la Salud y el Ambiente;

Community Coastal and Riparian Restoration at the Caño Boquilla Wetland System

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Impact
- Approved

RECAP: Puerto Rico Sea Grant outreach efforts helped to rehabilitated 4 miles of protected shoreline and riverine habitats severely impacted by the Hurricane Maria representing an economic investment of approximately \$15,000 dollars.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

Relevance: The Caño Boquilla Wetland System (CBWS) was designated in 2002 as the First Coastal Nature Reserve in the Municipality of Mayaguez because of its biological, historical, and archaeological value. Hurricane Maria severely impacted the coastal zone of the CBWS causing massive coastal deforestation and loss of essential habitat for protected bird species.

Response: Puerto Rico Sea Grant collaborated with local partners to develop and implement a series of restoration initiatives that advanced community knowledge and commitment and contributed to the post-hurricane recovery phase.

Results: Puerto Rico Sea Grant and partners restored 4 miles of coastal and riverine areas of the CBWS. Education and training events preceded the field activities. Ten different native species (650 coastal trees) were planted, 4,000 pounds of trash and marine debris were removed and 539 citizens participated in 32 outreach activities (18 on land restoration and 14 on water health) during restoration of the coast and the riverine margins of the estuaries.

PARTNERS: Agricultural Coop Extension Service, UPR; Dewey University; Guama Comunidad Agro ecoturística (GCA); Mayaguezanos Por la Salud y el Ambiente; National Fish and Wildlife Foundation (NFWF); Natural Resources Conservation Service (USDA, NRCS); Puerto Rico Department of Natural and Environmental Resources;

Puerto Rico Sea Grant Develops a Citizen Water Quality Monitoring Program

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Impact
- Approved

RECAP: The Caño Boquilla Reserve's (CBR) estuaries (Caño Maní, Caño Boquilla and Caño La Puente) discharges into the Mayagüez Bay, one of the most important sand beaches in the western Puerto Rico. It is a unique coastal-wetland ecosystem where many resident and migratory birds nest. Also, we can find marine mammals and the endanger tree species *Pterocarpus officinalis*.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

Relevance: Water quality data of the Caño Boquilla Reserve's is limited. The local agencies did not monitored this coastal ecosystem and its health condition is commonly unknown. The estuaries are continuously impacted by urban runoff, trash/waste disposal (plastics and biomedical) and residential development that disrupted the natural function of the area.

Response: Puerto Rico Sea Grant specialist and partners established a Citizen Water Quality Monitoring Program to obtained scientific information of the 3 main estuaries of the Reserve. The program trained 41 volunteers (21 youth and 20 adults) in water collection and monitoring techniques, weekly data were collected during 24 weeks. Volunteers were also trained to design and publish 8 water quality reports for a Weekly Podcast. Presence of biomedical wastes were observed during 8 field visits and geographic location was reported to Surfrider Foundation.

Result: The citizen monitoring program, with an economic investment of about \$15,000 dollars, revealed the relationship between the open channel condition (when estuaries were mixing with the marine environment) and good ecosystem's health (compliance with water quality standards). The project results were presented to the public throughout the podcasts, scientific presentations and the internet web page (<http://granreservaboquilla.wordpress.com>). The water quality data was share with the Water Quality Area of the DNER to be included in the 2017-2019 Biannual Report, better known as the 303(d)/305(b) Integrated Report. A graduate student developed her thesis research during the project implementation.

PARTNERS: Dewey University; Guama Comunidad Agro ecoturística (GCA); National Fish and Wildlife Foundation (NFWF); Mayaguezanos Por la Salud y el Ambiente; Lola Rodríguez de Tió, San Germán (Public High School); Puerto Rico Interamerican University, San German

Campus;

ASSOCIATED PROJECT(S):

MARINE OUTREACH PROGRAM (2018 - 2021)

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Volunteers participate in Tres Palmas Marine Reserve coral restoration

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Impact
- Approved

RECAP: Volunteers donate 587 hours of volunteer work for the restoration of coral reefs at the Tres Palmas Marine Reserve coral reefs.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

Relevance: From 2016 through 2017, Puerto Rico Sea Grant collaborated with HJR Reefscaping and Amigos de Tres Palmas to train students and community members on the use of NOAA's Coral Reef Monitoring Program methodologies. However, monitoring activities in TPMR were interrupted due to fragmentation of branched corals caused by Hurricane María. Given this situation, in addition to monitoring, restoration activities were necessary.

Response: Once Tres Palmas Marine Reserve damages were assessed, Isla Mar Research Expeditions requested the collaboration of HJR Reefscaping, the Department of Natural and Environmental Resources and Puerto Rico Sea Grant to coordinate the first community event for TPMR coral restoration. Puerto Rico Sea Grant conducted the logistics of the event and coordinated interagency and volunteer recruitment along with Amigos de Tres Palmas.

Results: A total of 1,005 coral fragments were reattached at the Tres Palmas Marine Reserve by volunteer who provided 587 hours to this initiative. Trained volunteers participated in TPMR monitoring activities, guided snorkeling tours to the restoration site and offered lectures about coral biology and restoration methodologies to community members.

PARTNERS: Amigos de Tres Palmas; HJR Reefscaping; Isla Mar Research Expeditions; Puerto Rico Department of Natural and Environmental Resources;

ASSOCIATED PROJECT(S):

MARINE OUTREACH PROGRAM (2018 - 2021)

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Volunteers remove 523 pounds of debris from Tres Palmas Marine Reserve as part of Puerto Rico Sea Grant post Hurricane María recovery actions

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Impact
- Approved

RECAP: Citizens join efforts to remove 523 pounds of debris from Tres Palmas Marine Reserve

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

Relevance: Hurricane María generated thousands of pounds of debris and millions of dollars' worth of damages. Being a tourist destination and an important natural attraction the Tres Palmas Marine Reserve was severely impacted by marine debris affecting an already fragile economy.

Response: Isla Mar Research Expeditions received a \$500 donation to carry out an activity that would help Puerto Rico's post-hurricane recovery. Isla Mar Research Expeditions selected Tres Palmas Marine Reserve as the place to carry out the event and reached Puerto Rico Sea Grant to collaborate as partners in this initiative.

Results: A debris removal event took place on April 2018 at Steps Beach. During the event, each participant had the opportunity to select between two volunteer activities, coastal cleanups and underwater clean ups. A total of 64 volunteers participated in coastal and underwater cleanups. A total of 288 volunteer hours were donated and 523 pounds of debris were collected and disposed.

PARTNERS: Isla Mar Research Expeditions;

ASSOCIATED PROJECT(S):

MARINE OUTREACH PROGRAM (2018 - 2021)

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Youth Ocean Explorers Summer Program

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development; Healthy Coastal Ecosystems; Resilient Communities and Economies

- Impact
- Approved

RECAP: The Youth Ocean Explorers Summer Program engaged 23 students in middle and high school and facilitated educational lessons both informal and formal. Students interacted with underrepresented STEM professionals and received open water scuba training which will help to better prepare them for careers in marine science. With continued support, VIMAS will launch this successful program on St. Croix in 2019 which will help to educate more VI youth about the importance of our natural resources.

PROGRAM FOCUS AREAS: Education and Workforce Development ; Environmental Literacy and Workforce Development; Healthy Ecosystems and Habitats; Resilient Communities and Economies

Relevance: Key points identified when students lose interest in STEM (Science Technology Engineering Mathematics); primarily around middle school. This leaky STEM pipeline can be attributed to numerous causes such as a lack of engagement in science concepts and limited science professionals that could serve as role models for these students. As a result many local Virgin Islanders do not envision themselves holding a career in the sciences which further intensifies this gap in science participation.

Response: The Youth Ocean Explorers Summer Program provides Virgin Islands youth with an opportunity to learn more about their natural environment through the use of engaging, hands-on approaches. Students are able to interact with underrepresented STEM-based professionals through the Coastal and Estuarine Research Federation (CERF) which allows these students to shift their negative perceptions of what a scientist looks like to a more positive one.

Results:

VIMAS Coordinator facilitated the YOE Summer Program for 23 students during the summer of 2018.

12 students from the YOE Summer Program were able to receive open water scuba training at a local dive shop.

VIMAS launched a free, 6-week swimming program for youth in grades K-12 and has recruited the assistance of YOE lifeguards and Red Cross certified Water Safety Instructors

PARTNERS: National Park Service (US DOI, NPS); University of Virgin Islands; Virgin Islands Department of Planning and Natural Resources; West Virginia University 4H; USVI Coastal Estuarine Research Federation; USVI Coki Dive Center; USVI Red Hook Dive Center; USVI STEM Institute; USVI Youths Diving with a Purpose;

ASSOCIATED PROJECT(S):

[VIRGIN ISLANDS MARINE ADVISORY SERVICE \(2018 - 2021\)](#)

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Reef Responsible - A Market driven approach to a sustainable commercial fishing industry in the Virgin Islands

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Impact
- Approved

RECAP: Virgin Islands Marine Advisory Service has been working with local restaurants to certify new and update original restaurants in the Reef Responsible program.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

Relevance: The demand for seafood is increasing yet many populations of fish are being overfished, especially around the island of St. Croix. This project promotes the purchasing and consuming of fish caught or farmed using environmentally friendly practices. It educates restaurants on purchasing fish that are legally caught using sustainable methods.

Response: Virgin Islands Marine Advisory Service has joined with staff from local agencies and organizations to develop an education and outreach program that promotes a sustainable fishing industry.

Results:

Seven restaurants on St. Thomas through the Reef Responsible Program.

2 Reef Responsible certified restaurants participated in the annual VIMAS Reef Fest event and prepared lionfish appetizers to over 800 participants at the event.

VIMAS worked with partners to certify 3 additional restaurants on STX as Reef responsible.

VIMAS worked with partners to run a Reef Responsible event in which over 500 people attended (Fish Fry) and 12 Reef Responsible restaurants participated.

PARTNERS: National Fish and Wildlife Foundation; The Nature Conservancy; Virgin Islands Department of Planning and Natural Resources; Reef Jam;

ASSOCIATED PROJECT(S):

[VIRGIN ISLANDS MARINE ADVISORY SERVICE \(2018 - 2021\)](#)

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Puerto Rico Sea Grant Triggers Marine Species Stock Restoration Program

NATIONAL FOCUS AREAS: Sustainable Fisheries and Aquaculture

- Impact
- Approved

RECAP: Recap: Puerto Rico Sea Grant outreach efforts improved practical aquaculture techniques at private land-based aquaculture facilities, and has been the engine for the initiation of a Puerto Rico Department of Natural and Environmental Resources marine species stock restoration program, at its Fisheries Resources Laboratory.

PROGRAM FOCUS AREAS: Sustainable Fisheries and Aquaculture

Relevance: Aquaculture offers a viable solution for the production of seafood products through the development of culture systems, based on artificial fish spawning and juvenile's production under controlled physical/chemical conditions.

Response: Puerto Rico Sea Grant developed an educational effort to expand and improve understanding on marine and freshwater aquaculture, aquaponics and population restocking for private entrepreneurs and government agencies.

Results: As a result of the Puerto Rico Sea Grant efforts, nine (9) general stakeholders and three (3) private entrepreneurs modified their practices using the knowledge gained on aquaculture practices for freshwater aquaponics, shrimp reproduction and ornamental aquarium settings for educational outreach purposes.

PARTNERS: Puerto Rico Department of Agriculture; Puerto Rico Department of Natural and Environmental Resources; Caribbean Fishery Management Council (CFMC); US Fish and Wildlife Service (US DOI, FWS);

ASSOCIATED PROJECT(S):

[MARINE OUTREACH PROGRAM \(2018 - 2021\)](#)

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Puerto Rico Sea Grant Collaborates with NOAA on Fisheries Data Acquisition

NATIONAL FOCUS AREAS: Sustainable Fisheries and Aquaculture

- Impact
- Approved

RECAP: Recap: Puerto Rico Sea Grant coordination of SEAMAP-C provided fisheries-independent populations' data acquisition on reef fish, conch and lobster, to support the CFMC and PR-DNER resources management plans, educational workshops on sampling methodologies, and outreach initiatives on fisheries scientific projects.

PROGRAM FOCUS AREAS: Sustainable Fisheries and Aquaculture

Relevance: The Southeast Area Monitoring & Assessment Program (SEAMAP) contributed to the development of fisheries independent baseline data, standards, and indicators to support ecosystem-based approaches to land use, water, fisheries, and other resource management. The information obtained is shared with a wide variety of constituents in Puerto Rico, the USVI and the Caribbean, Including the Gulf, South Atlantic and Caribbean Management Councils.

Response: Puerto Rico Sea Grant, through SEAMAP-C liaison activities, coordinated effective and efficient data collection during surveys, management and dissemination of fishery-independent data. The information collected included: marine bottom habitat mapping, reef fish fisheries-independent data, conch (*Strombus gigas*), lobster (*Panulirus argus*) pueruli settlement and juvenile abundance. The fisheries-independent data obtained from this long-term program is being used by students, scientists, and state and federal managers to describe population trends; explain responses to environmental factors; estimate stock abundance; and to track reproduction, recruitment and yields.

This information is essential for sustainable management fisheries decisions in PR and the USVI.

Results: The CFMC and Puerto Rico Department of Natural and Environmental Resources (PR-DNER) developed management plans for conch and reef fish based on population data obtained by SEAMAP-C. These efforts have improved precision and accuracy of the long-term reef-fish data collection through quality control evaluations.

PARTNERS: Caribbean Fishery Management Council (CFMC); Puerto Rico Department of Natural and Environmental Resources; Virgin Islands Department of Planning and Natural Resources; National Marine Fisheries Service (US DOC, NOAA, NMFS);

ASSOCIATED PROJECT(S):

[MARINE OUTREACH PROGRAM \(2018 - 2021\)](#)

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Puerto Rico Sea Grant Trusted as a Clearinghouse for Post-Hurricane Fishermen Assistance

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Impact
- Approved

RECAP: Puerto Rico Sea Grant staff served as a clearinghouse to provide commercial fishing groups affected by Hurricane Maria with cash, new dive equipment and fishing gear.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: During September of 2017 Puerto Rico and the USVI were devastated by back-to-back major Hurricanes (Irma and María). One year later, artisanal fishermen on the east coast of Puerto Rico are still fighting for resilience since federal and insular government aid has been unresponsive. Fishermen facilities and equipment including: boat ramps, lockers and piers, fishing arts and boats were completely destroyed or lost.

Response: Puerto Rico Sea Grant refocused its efforts in order to aid affected fishermen communities by organizing a fund-raiser. Funds raised were used to buy equipment and supplies for fishermen including new diving and fishing gear. Several NGOs identified Puerto Rico Sea Grant as a respected collaborator that could deliver funding and equipment among affected fishermen.

Results: Close to twenty-five (25) fishermen received cash, new dive equipment (tanks, fins, masks and other diving essentials) and fishing gear.

PARTNERS: Institute for Socio-ecological Research (ISER);

ASSOCIATED PROJECT(S):

[MARINE OUTREACH PROGRAM \(2014 - 2017\)](#)

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Puerto Rico Sea Grant Promotes Small-Scale Aquaponics Systems as a Sustainable Food and Nutrition Solution

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Impact
- Approved

RECAP: Recap: Puerto Rico Sea Grant successfully fosters proliferation of small-scale aquaponics to deliver fresh vegetables and animal protein whilst conserving precious fresh water and virtually eliminating impacts to coastal and marine resources.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: With the looming global crisis in food security projected by 2050 along with global trends in urbanization with arable land being lost to housing, there is a clear need to look for sustainable food solutions including reintegrating food production into cities.

Response: Puerto Rico Sea Grant refurbished an existing demonstrative aquaponics project at UPR-Mayaguez Campus by refitting hurricane damaged equipment and restocking fish and plant components. In addition, Puerto Rico Sea Grant recruited and trained a group of undergraduate volunteers regarding how to manage and maintain aquaponics systems. This project enabled visitors and workshop participants to envision and experience small-scale aquaculture systems as a clear path to food security.

Results: Puerto Rico Sea Grant coordinated three (3) workshops at the project demonstration premises. Twenty (20) volunteer undergraduate students and forty (40) adults were trained regarding aquaponics systems components, how to build and run your own small-scale system using easily accessible materials, and initial costs of building the system. Workshops were also offered at three (3) public schools and at three (3) major agricultural fairs. Close to five hundred (500) people have visited the project. Two retire persons and three local students have developed backyard aquaponic system. One of the aquaponic entrepreneurs is supplying mint to local bars for mojitos at \$14 per pound.

PARTNERS: Agricultural Coop Extension Service, UPR;

ASSOCIATED PROJECT(S):

MARINE OUTREACH PROGRAM (2018 - 2021)

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Puerto Rico Sea Grant Reduces Vulnerability to 28 Coastal Municipalities

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Impact
- Approved

RECAP: Puerto Rico Sea Grant and partners fostered capacity building efforts directed to coastal municipalities planners, engineers, and emergency managers, among others, to be aware and formally trained in the areas of resilience, coastal inundation mapping, planning for disaster recovery and green infrastructure for coastal resiliency

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: Hurricanes Irma and Maria devastation of Puerto Rico and US Virgin Islands highlights the necessity to educate and train professionals to ensure awareness of the impacts of future natural disasters. Capacity building and professional training can provide essential information and tools to develop awareness to natural disasters, climate change adaptation, resilience and mitigation strategies.

Response: Puerto Rico Sea Grant in collaboration with NOAA's Coastal Services Center and the National Preparedness Training Center of the University of Hawaii provided formal training to coastal municipalities planners, engineers, and emergency managers along Puerto Rico.

Results: Puerto Rico Sea Grant coordinated twelve (12) certified training/workshops related to resilience, coastal inundation mapping, and community planning for disaster recovery, climate adaptation for emergency management and green infrastructure for coastal resiliency. A total 375 participants from 28 coastal municipalities of Puerto Rico were certified, which helps to maintain their professional licenses, if they are engineers or planners receive certifications of contact hours with NDPTC. Help in the development of new projects for mitigation funds. They help develop community groups in the management of disasters and how to handle the event after the event. Enables the reduction of coastal vulnerability in relation to making coastal communities more resilient.

PARTNERS: University of Hawaii at Manoa, National Disaster Preparedness Training Center; Puerto Rico College of Engineers and Surveyors;

ASSOCIATED PROJECT(S):

MARINE OUTREACH PROGRAM (2018 - 2021)

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Puerto Rico Sea Grant Research Findings Serve as Foundation for a Beach Nourishment Project in Rincón PR

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Impact
- Approved

RECAP: Puerto Rico Sea Grant created a tool for determining oceanfront property cost from updated public records and sand volume using UAV and existing bathymetry and elevation data.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance

Rincon has one of the most rapidly eroding coastlines in Puerto Rico. In order to protect life and property beach restoration in many areas has been the method of choice. This method remains controversial due to its high cost and requires an adequate cost-benefit analysis.

Response

Two major obstacles were identified and addressed in this analysis. The first was the creation of a method for updating oceanfront property values from existing public records. The second was to estimate the volume of sand needed to extend the life of the beach and protect coastal infrastructure.

Results

During the study, the value of the oceanfront properties was successfully updated to present values and the sand volume was determined using UAV and existing bathymetry and elevation records. The value of coastal infrastructure was compared with the cost of protecting that property using beach restoration.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR);

ASSOCIATED PROJECT(S):

LIFE CYCLE COST ANALYSIS OF BEACH RESTORATION: RINCON, PR TESTBED (2014)

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Pa' la Playa beach safety information tool silently saving lives

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Impact
- Approved

RECAP: Pa' la Playa: the new mobile application that is helping users decide which beach to visit, considering marine and weather forecasts as determining factors is silently saving lives.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: From 2009 to 2019 there were 300 drowning incidents reported at the beaches of Puerto Rico not including boating incidents. On average 30 persons drown every year at the beaches of Puerto Rico as reported on a study conducted by Puerto Rico Sea Grant. The National Weather Service and the United States Lifesaving Association that ocean and weather information is very important to save lives.

Response: In recent years, Puerto Rico Sea Grant and CARICOOS have been working together to design, develop and promote the use of decision making tools to promote aquatic safety. As a result of this collaboration, on June 2018 CARICOOS launched a mobile application for beachgoers based on previous Puerto Rico Sea Grant 2014 funded research. The app was named by the public as Pa' la Playa and provides wind, waves and water quality observations and forecasts for 101 beaches of Puerto Rico.

Results: Since the launch of Pa' la Playa, 11,910 downloads and more than 70,000 screen views have been reported. At least 1,033 users are actively engaged with the tool. The most searched beaches in the app are those located on the north where the greatest number of drownings have been reported. Pa' la Playa has reached a lot of users and became an easy access tool and an effective beach safety information tool for beach goers

PARTNERS: Caribbean Integrated Coastal and Ocean Observing System (CarICOOS);

ASSOCIATED PROJECT(S):

MARINE OUTREACH PROGRAM (2018 - 2021)

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Puerto Rico Sea Grant empowers sponsored students to perform in robotics project and win the Rising Star Award

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development

- Impact
- Approved

RECAP: Puerto Rico Sea Grant robotics sponsored team won the Rising Star Award for their excellent performance during the First LEGO League, Inc. robotics tournament. Puerto Rico Sea Grant sponsored the team by providing training, fieldtrips, the robot, and the necessary materials to compete and present their research project.

PROGRAM FOCUS AREAS: Environmental Literacy and Workforce Development

RELEVANCE: Robotics, Science, Technology, Engineering, Art and Math (STEAM) education offer children a competitive head start in a variety of complex topics, while starting from simple concepts. Students develop different skills that help them effectively perform in current society, allowing the analysis of different situations, developing their critical thinking skills and teamwork, increasing their research capabilities and stimulating their curiosity.

RESPONSE: Puerto Rico Sea Grant sponsored the Hydrolions Sea Grant team of students from the Monserrate León de Irizarry High School in Cabo Rojo to participate in a robotics tournament sponsored by the First Lego League, Inc. Their research project consisted on the design of an innovative solution to a water contamination problem. Students designed and programmed a LEGO EV3 robot to solve the water quality problem.

RESULTS: After competing with 27 other teams, the Hydrolions achieved the Rising Star Award for their excellent performance in the robotics competition as well as their research project. The students developed skills, employed scientific, mathematical, technological, and engineering concepts to build and program a robot. They developed their creativity, intellect and capacity for research and investigation and were motivated to strive for established goals.

PARTNERS: Puerto Rico Department of Education;

Marine Debris Education and Community Engagement

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development

- Impact
- Approved

RECAP: Virgin Islands Marine Advisory Service increased awareness of marine debris and engaged over one thousand (1000) people in reducing marine debris in the VI. VIMAS will be expanding marine debris education through the NOAA marine debris grant.

PROGRAM FOCUS AREAS: Environmental Literacy and Workforce Development

Relevance: Marine debris is a deterrent to tourism, a human health hazard, degrades marine habitats and can impact marine plants and animals. If we are to mitigate this problem we must increase community awareness and engage the community in actions that will result in behavior change. Participating in coastal cleanups allow participants to engage in an activity which helps our marine environment and develops a sense of stewardship, promoting positive behavior change.

Response: Virgin Islands Marine Advisory Service increased awareness about the problem of marine debris and engaged the community in activities to address the issue. Virgin Islands Marine Advisory Service coordinated the annual coastal cleanup event in Sept. and Oct. In addition classroom presentations were made to local schools on the issue.

Results:

VIMAS Coordinators conducted 22 coastal cleanups, engaging over 800 volunteers and removing over 2500 pounds of debris.

VIMAS Coordinators conducted 28 classroom presentations to students in grades K-12 reaching over 800 students.

VIMAS Coordinator attended the 6th International Marine Debris Conference held in San Diego.

VIMAS Coordinator helped to facilitate the first ever Great Mangrove Cleanup which occurred on St. Thomas. Over 200 volunteers attended this cleanup which included students and residents of St. Thomas.

PARTNERS: Ocean Conservancy; USVI Waste Management Authority (WMA);

ASSOCIATED PROJECT(S):
VIRGIN ISLANDS MARINE ADVISORY SERVICE (2018 - 2021)

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Teachers complete their Masters degree using Sea Grant Program's curriculum guides and educational projects

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development

- Impact
- Approved

RECAP: The Sea Grant College Program from the University of Puerto Rico provided the necessary tools and knowledge to assist educators in completing their postgraduate degrees. These educators completed their projects grounding them on curricular materials and experiences produced by Puerto Rico Sea Grant enhancing ocean literacy among students.

PROGRAM FOCUS AREAS: Environmental Literacy and Workforce Development

RELEVANCE: There is a great need for teacher training opportunities in different areas in Puerto Rico, specifically those related to marine and coastal resources. As part of their work, educators are constantly searching for ways to improve their knowledge in order to provide quality teaching. Many of them pursue postgraduate studies, which provide necessary tools to become better prepared to face challenges and demands from the population they serve.

RESPONSE: The Sea Grant College Program from the University of Puerto Rico has designed several curriculum guides that provide educators with the tools necessary to teach about marine and coastal resources. Additionally, the Program provides training as to facilitate the integration of content in classrooms. Educators, as well as their students, have the opportunity to work in different projects, in order to develop critical thinking, analytical, research, and problem solving skills.

RESULTS: The implementation of these projects and the successful integration of Puerto Rico Sea Grant marine ecosystem curricular guides helped teachers succeed in their educational endeavors. Most recent examples are Professor Denys R. Ríos Grafals who created a Marine

Sciences course, which has been offered by San Juan's Robinson School since 2017. Prof. Professor Brenda Estévez actively worked with Sea Grant projects and products for over 10 years and evaluated student ocean literacy advancement.

PARTNERS: Puerto Rico Department of Education;

ASSOCIATED PROJECT(S):
MARINE EDUCATION (2018 - 2021)

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Puerto Rico Sea Grant provides educational tools to increase ocean literacy among local students

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development

- Impact
- Approved

RECAP: Puerto Rico Sea Grant provides educational materials and training on coastal and marine ecosystems to public and private schools teachers in an effort to increase ocean literacy among Puerto Rican K-12 students.

PROGRAM FOCUS AREAS: Environmental Literacy and Workforce Development

RELEVANCE: Education and awareness on the importance of coastal and marine ecosystems and resources services and conservation is crucial from an early age. In Puerto Rico however, the lack of academic material, hinders all efforts to implement these topics in classrooms.

RESPONSE: Puerto Rico Sea Grant produced and actively promotes the implementation of three peer-reviewed Coastal and Marine ecosystems Curriculum Educational Guides (CEG) that are endorsed by the Puerto Rico Department of Education. The focus of these educational tools is the development of ocean literacy among Puerto Rican students from an early age. The Curriculum Educational Guides provide information on mangrove forests, seagrass beds, and coral reefs. Puerto Rico Sea Grant provides workshops to help educators integrate these topics in their classrooms.

RESULTS: In 2018, approximately 38 educators from public and private schools, as well as educators from the Department of Natural and Environmental Resources participated in this initiative. To date, 633 educators have implemented the CEG, and 137,604 students have benefited from these efforts. Training provided by Puerto Rico Sea Grant represents savings close to \$300,000 in training costs for the Puerto Rico Department of Education. A significant learning gain was among students was identified and documented.

PARTNERS: Puerto Rico Department of Education; Puerto Rico Department of Natural and Environmental Resources;

ASSOCIATED PROJECT(S):
MARINE EDUCATION (2018 - 2021)

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Puerto Rico Sea Grant Connects Teachers to Marine Science Through Professional Development Opportunities to Enhance Ocean Literacy.

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development

- Impact
- Approved

RECAP: A teacher-training model developed by Sea Grant received high marks from educators. The model coaches' participants on marine topics, provides educational materials, offers strategies and motivates teachers to keep participating in the program to enhance ocean literacy.

PROGRAM FOCUS AREAS: Education and Workforce Development ; Environmental Literacy and Workforce Development

RELEVANCE: Most Puerto Rican teachers lack training and resources to incorporate Puerto Rico-relevant marine and aquatic education into their instruction, resulting in K-12 students lacking marine literacy skills and opportunities to engage in field trip and stewardship activities during the school year.

RESPONSE: During 2018, Puerto Rico Sea Grant's marine education specialist developed workshops for K-12 teachers and informal educators that addressed topics related to coastal ecosystems and coastal resilience. The objective was an approach to increase the knowledge in marine science of Puerto Rican teachers, and help enrich science curricula.

RESULT: In 2018, Puerto Rico Sea Grant trained a total of 94 teachers from K-12 levels in marine science subjects. This effort spared the Department of Education of Puerto Rico a total of \$15,980.00 in training expenses. The teachers benefited from updated information, materials and educational strategies used in the classroom for enriching the teaching-learning process. Pre and post-test assessment indicated a significant improvement of 78% in participant content knowledge. This program will impact approximately 18,271 students.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR); Puerto Rico Department of Education;

Puerto Rico Coral Reef Ecosystem Valuation study is available in Spanish

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant translates to Spanish a market valuation of coral reefs study providing an easier way of economically understanding their contribution to society in an effort to protect coral reefs and ensure their survival.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

Relevance: Puerto Rico Sea Grant, the National Oceanic and Atmospheric Administration, the Environmental Protection Agency, the Office of National Marine Sanctuaries, National Ocean Service, Ridge to Reefs and the Puerto Rico Tourism Company united efforts to generate the necessary data to make decision-makers clearly aware of the value of coral reefs to economy and society. Our aim was to protect our reefs systems from anthropogenic stresses.

Response: Puerto Rico Sea Grant translated a non-market valuation of reef attributes assembled from survey responses of reef-visitors in Puerto Rico was documented and presented in six reports. The value of reefs was characterized so that individuals and organizations can be fully aware of the consequences of decisions, large and small, that affect coral reefs.

Results: Important information generated by this study was translated to provide the non-English speaking population of Puerto Rico the knowledge necessary to understand why coral reefs should be protected and imparts a stronger argument for ensuring their survival.

PARTNERS: Office of National Marine Sanctuaries (US DOC, NOAA, NOS, ONMS); NOAA in the Caribbean; Environmental Protection Agency; Puerto Rico Tourism Company; Ridge to Reefs;

ASSOCIATED PROJECT(S):
COMMUNICATIONS AND PUBLICATIONS (2018 - 2021)

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Benthic foraminifera and the FORAM Index: application and implementation in the coral reef monitoring plan in Jobos Bay National Estuarine Research Reserve System in Puerto Rico

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Accomplishment
- Approved

RECAP: Foram Index values show that most of the fore reef and lagoonal sites between Cayo Caribe, Cayo Barca, Cayo Morrillo, and Cayo Pajaros are "conducive for reef growth". In particular, the fore reef side of Cayo Caribe is an "environment not conducive for reef growth and unsuitable for recovery".

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

Relevance: Coral reefs in Puerto Rico are negatively influenced by habitat encroachment and degradation. Standard assessment for coral reef health is to determine live coral cover however; there is a known time lag between stress exposure and coral responses. Implementing benthic foraminifers and its associated FORAM-Index as an indicator of coral health will provide Jobos Bay National Estuarine Research Reserve with a bio-indicator that will serve as an "early" warning system for coral reef monitoring.

Response: This research project is currently evaluating the application of benthic foraminifera (shelled protists) as a proxy of coral reef water quality. This is done in close collaboration and partnership with Jobos Bay National Estuarine Research Reserve personnel. By engaging in a multi-year seasonal study, we aim to identify the optimal sampling sites as well as time of year to maximize the efforts of JBNERR personnel.

Results: The Foram Index values show that most of the studied reefs are "conducive for reef growth" although the fore reef side of Cayo Caribe is an "environment marginal for reef growth and unsuitable for recovery", which translates to mesotrophic conditions. Although no relation is observed between the recorded abiotic variables and Foram Index, it is indicating that the conditions for Cayo Caribe are much stressed and they can take proactive action.

PARTNERS: Florida A&M University (FAMU);

ASSOCIATED PROJECT(S):

Puerto Rico is in need of management measures in order to protect Bottlenose dolphin

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Accomplishment
- Approved

RECAP: Bottlenose dolphin population in Puerto Rico is in need of management measures in order to protect this specie.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

RELEVANCE: The bottlenose dolphin (*Tursiops truncatus*) is commonly found around Puerto Rico and consists of coastal and pelagic ecotypes. No population assessment has been done in Puerto Rico to determine the extent, distribution and any possible interactions between the two ecotypes. The unknown population composition and relationship between the two ecotypes presents challenges in the management of this species as defined in the Marine Mammal Protection Act of 1972.

RESPONSE: Puerto Rico Sea Grant researchers in collaboration with the University of Puerto Rico Marine Science Department conducted an in-depth study of a species poorly known in Puerto Rico. For the first time, free ranging dolphins from a known population were sampled and its population structure defined.

RESULTS: For the first time, free ranging dolphins from a known population were sampled and their population structure defined. In summary, the bottlenose dolphin population that inhabits the south and west coast of Puerto Rico exhibits complex dynamics and distribution patterns. This research concludes that the bottlenose dolphin population in Puerto Rico is in need of management measures in order to protect this specie.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR);

ASSOCIATED PROJECT(S):

GENETIC STRUCTURE AND DIVERSITY OF BOTTLENOSE DOLPHIN, *TURSIOPS TRUNCATUS*, OFF PUERTO RICO (2014 - 2015)

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Puerto Rico Sea Grant published a book on marine mammals of Puerto Rico and the Virgin Islands

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant published the book Marine Mammals of Puerto Rico and the Virgin Islands in order to provide valuable information about these species and their protection.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

Relevance: A comprehensive overview of the diverse marine mammal fauna of the Caribbean Sea is composed of 32 species 27 of which have been documented close to Puerto Rico and the US Virgin Islands. The regional management and conservation efforts of Caribbean marine mammals is directly related to countries' commitment to establish conservation priorities, standards and strategies for their conservation and education.

Response: Puerto Rico Sea Grant produced the book Marine Mammals of Puerto Rico and the Virgin Islands as part of our efforts to educate resource users and managers about the need to establish conservation priorities, standards and strategies for marine mammals conservation and education. Information provided includes their morphology, population, feeding, mating habitats, main threats faced by these species and identifies ways in which humans can contribute to their protection. The book contains high quality images and illustrations of marine mammals found in our waters.

Results: An easily accessible marine mammals book (*Mamíferos marinos de Puerto Rico e Islas Vírgenes*) with high quality images and illustrations was published in both printed and digital formats. The book can be read or downloaded from the PRSG website: <https://seagrantpr.org/communications-and-publications/books/>.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR);

ASSOCIATED PROJECT(S):

COMMUNICATIONS AND PUBLICATIONS (2018 - 2021)

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Puerto Rico Sea Grant coordinates the First Training on the Use and Application of Drone Technology to Scientific Research and Management of Natural Resources

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development; Healthy Coastal Ecosystems

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant gathered and trained scientific researchers and natural resources managers to promote the technology of drones and its application to different scientific disciplines and natural resources management.

PROGRAM FOCUS AREAS: Education and Workforce Development ; Environmental Literacy and Workforce Development; Healthy Ecosystems and Habitats

Relevance: Technology is becoming very important in all fields of work and even though Unmanned Aerial Vehicles (UAVs) were developed for the espionage and defense industries, its application has expanded and developed to advance human knowledge through scientific research and seek solutions to natural resources problems. Applications to research and resources management include mangrove communities, coral reefs, endangered species and coastal erosion mapping and monitoring activities.

Response: Puerto Rico Sea Grant coordinated the first training on the use of drones for scientific research and natural resources management, which consisted of theory and practice offering the opportunity to learn about FAA airspace laws and regulations, uses, applications, data collection and analysis, how and where to fly AUVs, and practice and other valuable information. Participants were given written tutorials, learned flying techniques and skills, mapping, legal and safety considerations, software and hardware options, pre-flight planning and flight day management.

Results: There was a positive response from the participants and presenters of the training, who requested continued education opportunities related to the use of drones.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR);

ASSOCIATED PROJECT(S):

[COMMUNICATIONS AND PUBLICATIONS \(2018 - 2021\)](#)

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Climate Education for Virgin Islands High School Students

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems; Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Virgin Islands Marine Advisory Service has continued to provide students and the community with the necessary information to understand global climate change and how they can work to mitigate it. Funds for 2018-19 were secured for additional climate change education. Funds secured through the NOAA Environmental Literacy Program will enable climate change education to be offered to middle and high school aged students on St. Thomas and will spill-over into at-risk communities to climate change.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats ; Resilient Communities and Economies

Relevance: Island communities are particularly vulnerable to the impacts of climate change. Small islands have a major portion of its population located in coastal areas threatened by increased sea level rise. Impacts from sea level rise, increasing sea water temperatures and increases in the intensity of hurricanes as well as other effects of climate change will continue and intensify in coming years. Despite its vulnerability, the local population has little knowledge or understanding of climate change science.

Response: This project provides climate change education to high school students so that they are better equipped to adapt to the changing climate and its local impacts as they continue their education and enter the workforce. Increased awareness of the problem assists with better resource management and planning and better mitigation of climate change impacts, and the reduction of individual carbon footprints through changes in behavior.

Results: Virgin Islands Marine Advisory Service provided climate change education to high school students by providing eight climate change presentations to environmental science classes on St. Croix. Pre/post tests show significant improvement in climate change literacy in the students who participated. In addition, VIMAS is working alongside University of Virgin Islands researchers and other community partners on NOAA Environmental Literacy program called USVI Storm Strong VIMAS has a presence on the Long Term Recovery Team and Sustainability Taskforce formed after hurricane Maria

PARTNERS: Federal Emergency Management Agency (US DHS, FEMA); Virgin Islands Department of Education; NOAA in the Caribbean;

ASSOCIATED PROJECT(S):

[VIRGIN ISLANDS MARINE ADVISORY SERVICE \(2018 - 2021\)](#)

Development of a cost-efficient assessment tool to prevent the establishment of invasive marine species in Puerto Rico

NATIONAL FOCUS AREAS: Healthy Coastal Ecosystems

- Accomplishment
- Approved

RECAP: Our project will provide resource managers with a practical tool kit to help prevent local ecosystem damage and economic losses from invasive species, while integrating outreach activities to increase stakeholder awareness and stewardship of Puerto Rican waters.

PROGRAM FOCUS AREAS: Healthy Ecosystems and Habitats

RELEVANCE: Biological invasions have been estimated to cost US\$ 314 billion per year to the US economy. Critical to management are cost-efficient assessment tools to quickly detect the arrival of new species, monitor the spread of established ones, understand the introduction pathways utilized by invasive species, and design adequate containment and eradication plans.

RESPONSE: Our project focuses on ascidians as bioindicators of invasive species introductions, spread and ecosystem impacts. Through extensive on-site surveys, we will construct (1) a Puerto Rican ascidian 'Species Catalogue', (2) a 'Watch List', and (3) an accessible, web-based 'Assessment Tool' to identify, monitor and manage species introductions along the Puerto Rican coastline.

RESULTS: Stakeholder involvement is critical to ensure continuous species monitoring and long-term mitigation of the negative impacts of species introductions: invasion processes are dynamic and new species can arrive and spread at any time. Accordingly, our project emphasizes results dissemination and outreach efforts targeting diverse stakeholder groups, including training sessions with resource managers, and presentations for the general public (English and Spanish).

PARTNERS: University of North Carolina, Wilmington (UNCW);

ASSOCIATED PROJECT(S):

DEVELOPMENT OF A COST-EFFICIENT ASSESSMENT TOOL TO PREVENT THE ESTABLISHMENT OF INVASIVE MARINE SPECIES IN PUERTO RICO (2018 - 2019)

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Outreach Fisheries & Aquaculture Electronic Portal

NATIONAL FOCUS AREAS: Sustainable Fisheries and Aquaculture

- Accomplishment
- Approved

RECAP: Recap: More than 392 visitors "hits" from twelve (12) different countries have been received at the Puerto Rico Sea Grant electronic portal "Marine Outreach Program in Fisheries and Aquaculture, Puerto Rico Sea Grant College Program", which promotes collaborative ecosystem based management and sustainable fisheries practices.

PROGRAM FOCUS AREAS: Sustainable Fisheries and Aquaculture

Relevance: Ecosystem based management includes common different criteria including ecological health, sustainability and the human dimension within the ecosystem framework. Marine users from public and private sectors have an imperative need for direct support and advice to increase their appreciation of coastal and marine ecosystems and integration into collaborative ecosystem-based management.

Response: Puerto Rico Sea Grant developed and offers access to the electronic "blog" <http://prsgfisheriesoutreach.wordpress.com/>. Relevant information related to fisheries and aquaculture outreach and research conducted by MOP has been summarized and posted for forum discussions.

PARTNERS: Caribbean Fishery Management Council (CFMC); Federación de Pescadores de Puerto Rico y Defensores Del Mar, Inc. (FEPDEMAR); Puerto Rico Department of Agriculture; Puerto Rico Department of Natural and Environmental Resources; Sociedad Ambiente Marino; Pew Charitable Trusts;

ASSOCIATED PROJECT(S):

MARINE OUTREACH PROGRAM (2018 - 2021)

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Puerto Rico Sea Grant Develops Effective Fisheries Information Dissemination

NATIONAL FOCUS AREAS: Sustainable Fisheries and Aquaculture

- Accomplishment
- Approved

RECAP: Recap: Puerto Rico Sea Grant serves as a long-term outreach facilitator and a non-advocate provider of information to a diverse group of local fishers including commercial, recreational, sport and wild ornamental fishers. Information has been also disseminated among state and federal resource managers.

PROGRAM FOCUS AREAS: Sustainable Fisheries and Aquaculture

Relevance: In order to ensure continued productivity on marine fisheries resources, managers need to develop an integrated process of information gathering to aid in the analysis, planning, decision making and allocation of resources backed by the enforcement of regulations that govern fishing activities.

Response: Puerto Rico Sea Grant provided advisory services to help commercial fishers (~1200) to set priorities and develop long-range plans. Services include recommendations to fisheries resource managers on matters related to regulations, government incentive programs, and other critical fishers' needs. Particularly services were offered to the Puerto Rico Department of Natural and Environmental Resources, and the Puerto Rico Department of Agriculture. Outreach included technical support to maintain commercial and recreational fishers informed about fishing regulations, biological aspects of regulated species, and issues dealing with environmental conservation.

Results: Puerto Rico Sea Grant sits at the Puerto Rico Department of Natural and Environmental Resources Fisheries Advisory Board as the Scientific Academy representative providing specialized recommendations to resource managers (~10), commercial and recreational fishers (~300) and over (~43) direct stakeholder's interactions.

PARTNERS: Puerto Rico Department of Agriculture; Puerto Rico Department of Natural and Environmental Resources; Caribbean Fishery Management Council (CFMC); Federación de Pescadores de Puerto Rico y Defensores Del Mar, Inc. (FEPDEMAR);

ASSOCIATED PROJECT(S):

MARINE OUTREACH PROGRAM (2018 - 2021)

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Developing the Next Generation of Aquaculture Professionals

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Recap: Puerto Rico Sea Grant in collaboration with the UPR-Mayaguez Campus, College of Agricultural Sciences fosters the new generation of aquaculture professionals through a formal undergraduate course that is part of the Animal Science Program curriculum.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: Future increases in seafood availability and the varieties of aquatic species will depend on the continued development and expansion of aquaculture as an essential component of the world's food supply. However, there is an urgent need for information with respect to scientific and technical aspects of marine culture, including: nutrition and feeds, health and disease, spawning and larval rearing technology and genetics of cultured species.

Response: Together with the Animal Science Program of the College of Agricultural Sciences, Puerto Rico Sea Grant designed and offered a three (3) credit course Introduction to Aquaculture, CIAN 4050. The course focused on management practices used in the cultivation and production of important aquaculture species. The main objective of the course is to develop a cadre of professionals entitled to work on established aquaculture businesses and stimulate graduate studies on this field.

Results: Twenty (20) undergraduate students from the Animal Science Program of the College of Agricultural Sciences enrolled and approved the three credit course Introduction to Aquaculture.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR);

ASSOCIATED PROJECT(S):

MARINE OUTREACH PROGRAM (2018 - 2021)

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Puerto Rico Sea Grant Collaborates to Establish a Fish Aggregating Device (FADs) System

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Recap: Puerto Rico Sea Grant collaborates with the Department of Natural and Environmental Resources and local fishermen to develop a FADs program for the west and south coasts of Puerto Rico.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: FADs provide an array of direct and indirect benefits to fishing communities and economies increasing catch per unit of effort, reducing pressure on reef resources, reducing reliance on imports and increasing demand for tourism activities.

Response: Puerto Rico Sea Grant submitted a proposal and is expecting an award of \$129,980 from the U.S. Fish and Wildlife Sports Fishing Restoration funds for the installation of four (4) fish aggregating devices (FADs) on the West and South coasts of Puerto Rico. FADs are expected to enhance recreation and economic opportunities on the area.

PARTNERS: US Fish and Wildlife Service (US DOI, FWS); Puerto Rico Department of Natural and Environmental Resources; Caribbean Integrated Coastal and Ocean Observing System (CarICOOS); Marina Pescaderia Puerto Real; Club Deportivo del Oeste; Balsas del Oeste, Inc.;

ASSOCIATED PROJECT(S):

[MARINE OUTREACH PROGRAM \(2018 - 2021\)](#)

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Puerto Rico Sea Grant/4-H Fisheries and Aquaculture Summer Camp

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Recap: Three talented disadvantaged youths with interest in a sustainable future were positively impacted and recruited through positive experiences and individual attention to the exciting aquaculture and scientific research fields.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: Food insecurity and hunger have been major development priorities for a long time, and are being exacerbated by climate variability, price volatility and overconsumption. Over the next decades, food production systems will have to provide for a world population of 9 billion people.

Response: Puerto Rico Sea Grant designed and coordinated a summer camp to recruit potential new college students to the areas of fisheries and aquaculture sciences by providing access and educational experiences on a marine science research field station, agricultural experimental station and private aquaculture farm.

Results: A total of twenty-five (25) 4-H Youth from 15 to 18 years old were selected for their college academic potential and interest in fisheries and aquaculture sciences. Students learned about the crucial role fisheries and aquaculture research will play during the next decades with regards to world food security and coastal and marine ecosystems management

PARTNERS: Puerto Rico Department of Education; Puerto Rico Department of Natural and Environmental Resources; University Of Puerto Rico, Mayaguez (UPR); 4-H Clubs Program; Agricultural Coop Extension Service, UPR; Caribe Fisheries, Inc.; Astronomic Society of the Caribbean;

ASSOCIATED PROJECT(S):

[MARINE OUTREACH PROGRAM \(2018 - 2021\)](#)

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Puerto Rico Sea Grant Help Students and Teachers Understand Climate

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant provided hands-on experiences to 9-12 grade students related to sea level rise, ocean acidification, ocean observations, resilience, adaptation and mitigation through guided educational field trips to the Los Morrillos Light House and its surrounding coastal ecosystems.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: During September 2017 hurricanes Irma and Maria devastated Puerto Rico and the USVI. Non-traditional education is an essential element to help students understand the need to adapt to the impacts of global warming and encourage changes in attitude and behavior.

Response: Puerto Rico Sea Grant's Center for the Education on Environmental Climate Change conducted several field trips to help high school students and teachers explore climate change through the use of interactive and engaging activities. A hundred and twenty-eight (128) high school students and twenty (20) teachers participated in the fieldtrips.

PARTNERS: Municipality of Cabo Rojo, Puerto Rico;

ASSOCIATED PROJECT(S):

[MARINE OUTREACH PROGRAM \(2018 - 2021\)](#)

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The ABC of hurricanes: A Booklet to Increase Resiliency

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant in collaboration with the Interdisciplinary Center for Coastal Studies at the University of Puerto Rico developed a chronological study about the history of major hurricanes in Puerto Rico and published a set of booklets that include the basics of hurricane science.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: The aftermath of the destruction of hurricanes Irma and Maria through Puerto Rico and the Caribbean reflects the need to increase awareness of extreme weather events as hurricanes.

Response: Two documents: "Cartilla de los Ciclones" and "Actividad Ciclónica en Puerto Rico y sus alrededores: 1867 al 2017" were published. Both publications and additional resources can be found in: www.proyecto1867.com ("Desastres y Memoria en Puerto Rico"). Over five hundred copies of the booklet have been distributed among Emergency Management offices and residents of Puerto Rico.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR);

ASSOCIATED PROJECT(S):

[MARINE OUTREACH PROGRAM \(2018 - 2021\)](#)

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Puerto Rico Sea Grant and CIEL Developed Geo-rectification Tool for Coastal Areas

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: In collaboration with the Interdisciplinary Center for Coastal Studies Puerto Rico Sea Grant geo-referenced 1930s and 1950s aerial photographs for the coastal areas of Puerto Rico and provided a resource for land use planning and management, historical landscape change analysis, erosion and coastal change analysis, and climate changes studies. Access to the data is on: <https://prgeoref.weebly.com/> The aerial photographs were geo-referenced to the North American Datum of 1983, Puerto Rico State Plane Coordinate System.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: Aerial photographs are instrumental tools for visualizing, monitoring, and determining changes at the landscape level at different temporal and spatial scales. In the case of coastal hazards, historical aerial photographs provide a way of comparing coastal changes prior and after a disaster.

Response: In collaboration with the Interdisciplinary Center for Coastal Studies Puerto Rico Sea Grant geo-referenced 1930's and 1950's historical aerial photographs for the coastal areas of Puerto Rico.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR);

ASSOCIATED PROJECT(S):

[MARINE OUTREACH PROGRAM \(2018 - 2021\)](#)

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Only a Quarter of Rincón,s Flood Zone Habitants Will Make it to a Safe Zone in Tsunami Evacuation

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant researchers calculated evacuation routes and times for Tsunami (extreme event) flood hazard at coastal community in Rincon, Puerto Rico. Only twenty-five percent (25%) of Rincón's habitants will make it to safe zones in less than 5 minutes.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: Pedestrian evacuation models (PEM) can be used to better understand how the population can escape an at-risk area. Rincón, Puerto Rico a major tourist destination presents a real challenge for the residents and employees to reach safety in case of a tsunami. Past historical tsunami data, along with current tsunami flood models indicate that after the onset of a local event, the first tsunami wave can arrive as early as in 5 minutes.

Response: Puerto Rico Sea Grant advanced the understanding of the vulnerability to floods of Rincon's neighborhoods. Rincón's flood-prone zones were characterized in terms of exposure, sensitivity and adaptive capacity. Multiple meetings were conducted with Rincón's emergency responders and strategic planners in support of the development of mitigation, response and recovery strategies for floods.

Results: The model that best addresses the needs of people living in the floodable areas of Rincon neighborhoods is the Tsunami Evacuation Model evaluated for pedestrian evacuation. The times calculated suggest that only a quarter of the habitants in the flood zone will make it to safe zones in less than 5 minutes and another 40-50 % in less than 15 minutes.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR);

ASSOCIATED PROJECT(S):

[EXPOSURE AND ADAPTIVE CAPACITY TO FLOODS: A COMPREHENSIVE VULNERABILITY ASSESSMENT OF RINCON'S NEIGHBORHOODS \(2014\)](#)

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Municipality of Vega Baja gets the Blue Flag award for the first time

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Two beaches successfully meet the management, educational and safety standards of the Blue Flag Program and receives an award for their outstanding performance.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance: The Blue Flag Program was established in 1987 in Denmark to award beaches, marinas and tourism operators around the world for its outstanding efforts to maintain exceptional standards in four main areas: management, environmental educational, safety, and access. The Blue Flag Program is a world-renowned eco-label trusted by millions of people around the world. For more than 10 years Puerto Rico Sea Grant has been a member of Puerto Rico's Blue Flag Jury.

Response: Puerto Rico Sea Grant along with the Puerto Rico Aqueduct and Sewer Authority (PRASA) inspected three Blue Flag applicants: Escambrón, Punta Salinas and Puerto Nuevo. During the inspections and considering that this was the first inspection right after Hurricane María, in such short time, two of the three applicants demonstrated a great improvement with regards to debris management and water quality.

PARTNERS: Organización Pro Ambiente Sustentable (OPAS); Blue Flag; Municipality of Vega Baja; Puerto Rico Aqueduct and Sewer Authority (PRASA);

ASSOCIATED PROJECT(S):

[MARINE OUTREACH PROGRAM \(2018 - 2021\)](#)

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Towards Potential Beach Nourishment in Rincón: Seamless RTK Surveying and Sediment Compatibility Analysis

NATIONAL FOCUS AREAS: Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant created a tool for determining oceanfront property cost from updated public records and sand volume using UAV and existing bathymetry and elevation data.

PROGRAM FOCUS AREAS: Resilient Communities and Economies

Relevance

Rincon has one of the most rapidly eroding coastlines in Puerto Rico. In order to protect life and property beach restoration in many areas has been the method of choice. This method remains controversial due to its high cost and requires an adequate cost-benefit analysis.

Response

Two major obstacles were identified and addressed in this analysis. The first was the creation of a method for updating oceanfront property values from existing public records. The second was to estimate the volume of sand needed to extend the life of the beach and protect coastal infrastructure.

Results

During the study, the value of the oceanfront properties was successfully updated to present values and the sand volume was determined using UAV and existing bathymetry and elevation records. The value of coastal infrastructure was compared with the cost of protecting that property using beach restoration.

PARTNERS: University Of Puerto Rico, Mayaguez (UPR);

ASSOCIATED PROJECT(S):

TOWARDS POTENTIAL BEACH NOURISHMENT IN RINCON: RTK BEACH MAPPING, SEDIMENT COMPATIBILITY ANALYSIS AND AN ONLINE TOOL FOR DATA SHARING (2014)

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Marine Nature and Conservation Newspaper Column

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development

- Accomplishment
- Approved

RECAP: Virgin Islands Marine Advisory Service is increasing marine education by regular newspaper submissions and other media.

PROGRAM FOCUS AREAS: Environmental Literacy and Workforce Development

Relevance: If the community is to protect and conserve marine resources they need to have an understanding of them. This can be done in a variety of ways such as publications, public and school presentations, field activities, as well as through the media. This project involved writing articles on marine nature and conservation as well as promoting the VIMAS program and website. VIMAS increased this type of education by writing for the newspaper and other media.

Response: VIMAS has started to make more regular submissions to the local media in order to increase awareness of marine issues.

Results:

2 News articles were published on Youth Ocean Explorers (YOE), one article in the St. Thomas Source and the other through the UVI Blog.

VIMAS published an article in the St. Thomas Source about high school students learning to SCUBA.

VIMAS published an article in the St. Thomas Source about VIMAS offering swimming classes on St. Thomas.

VIMAS St. Thomas published an article in the V.I. Consortium about YOE Program launched on St. Croix.

PARTNERS: University of Virgin Islands;

ASSOCIATED PROJECT(S):

VIRGIN ISLANDS MARINE ADVISORY SERVICE (2018 - 2021)

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Puerto Rico Sea Grant educational effort inspires youngster to teach communities about climate change and impacts to coastal and marine resources

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant Sandwatch Project motivated a participant of this educational effort to develop the non-profit organization Florece y Respira PR, Inc. to educate about climate change in Puerto Rico and promote environmental conservation.

PROGRAM FOCUS AREAS: Environmental Literacy and Workforce Development

RELEVANCE: As stated on the Sandwatch manual "environmental education is a process aimed at developing a population that is aware of, and concerned about, the total environment and its associated problems, and which has the knowledge, attitudes, skills, motivation and commitment to work individually and collectively towards solutions of current problems and the prevention of new ones."

RESPONSE: Puerto Rico Sea Grant has been a Sandwatch program collaborator since 2002, to provide first-hand knowledge to people of all ages, on the issues affecting coastal and marine resources. Sandwatch provides the framework for school students with the help of their teachers, and local communities, to work together to critically evaluate the problems and conflicts facing their beach environments and to develop sustainable approaches to address these issues.

RESULTS: A high school student that participated in the Puerto Rico Sea Grant sponsored Sandwatch Project raised awareness about climate change and the importance of preserving the environment. This experience and inspired her to create the NGO Florece y Respira PR, Inc., a movement to educate about climate change impact in Puerto Rico. As part of this effort, this NGO coordinates educational events including: beach cleanup activities, student orientations, and workshops aimed to improve coastal and marine resources health.

PARTNERS: UNESCO;

ASSOCIATED PROJECT(S):
MARINE EDUCATION (2018 - 2021)

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Puerto Rico Sea Grant Collaborates on Educating and Improving Tsunami Awareness in School Communities.

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development; Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant and partners provide educators with information, strategies, and materials to engage students on the science and awareness of earthquakes and tsunamis

PROGRAM FOCUS AREAS: Education and Workforce Development ; Environmental Literacy and Workforce Development; Resilient Communities and Economies

RELEVANCE: The danger of a tsunami in Puerto Rico is real. Since 1867, two tsunamis have affected coastal regions, causing death and destruction. The majority of Puerto Rico's population lives in tsunami vulnerable zones. Considering tsunamis are unpredictable, school communities must make an effort to increase resilience and awareness. Teaching tsunami science and safety to young children fosters a culture of responsibility for disaster readiness at an early age.

RESPONSE: In collaboration with the Puerto Rico Seismic Network, the Department of Education and the University of Puerto Rico at Humacao Campus, the Puerto Rico Sea Grant Program developed a two-day workshop for K-12 teachers about the science and preparedness before, during and after a tsunami.

Result: Ninety percent of educators registered in the 2018 Great Puerto Rico Shake Out, where they practiced how to drop, cover, and hold on, during the Great Shake Out Earthquake Drills. The nineteen teachers that attended rated the workshop activities as excellent. Pre and post-test assessments indicated a significant improvement of 73% in participant content knowledge.

PARTNERS: Puerto Rico Department of Education; Puerto Rico Seismic Network; University Of Puerto Rico, Humacao (UPR);

ASSOCIATED PROJECT(S):
MARINE EDUCATION (2018 - 2021)

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Puerto Rico Sea Grant Brings K-12 Students Knowledge in Marine Science

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant Marine Science Adventure Program and its partners contribute to the development of a future workforce that understands the need to use coastal and marine resources responsibly.

PROGRAM FOCUS AREAS: Environmental Literacy and Workforce Development

RELEVANCE: Scientific understanding of the ocean and its importance, need to be part of the culture and education in school curriculums of the educational system of Puerto Rico. Our schools offer very few marine educational experiences to students, resulting in little to no interest in studying, investigating or even more to pursuing a professional career in the field of marine sciences. A knowledgeable citizenry is essential to guarantee a sustainable future for marine and coastal environments.

RESPONSE: Puerto Sea Grant developed the Marine Science Adventure Program for K-12 students, which includes a wide range of activities and high-quality learning experiences with corresponding support services for school-aged children and teachers. The Puerto Rico Department of Education authorized students to participate in field trips to different coastal nature reserves, laboratory experiences and marine exhibits.

RESULTS: In 2018, Puerto Rico Sea Grant and the Marine Science Adventure Program developed 46 educational events for 2,276 K-12 level students and 148 teachers from 35 schools in Puerto Rico. According to the evaluation data, 70% of the participants had not partaken in activities like these where participants become familiar with scientific instruments and collect data to analyze in their classroom. Results also proved that, given the success of the program, marine topics are becoming increasingly attractive among students participating in science fairs.

PARTNERS: Puerto Rico Department of Education;

ASSOCIATED PROJECT(S):
MARINE EDUCATION (2018 - 2021)

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Puerto Rico Sea Grant Advances Climate Change Education among the Puerto Rico Department of Natural and Environmental Resources Personnel

NATIONAL FOCUS AREAS: Environmental Literacy and Workforce Development; Resilient Communities and Economies

- Accomplishment
- Approved

RECAP: Puerto Rico Sea Grant collaborated with the Puerto Rico Department of Natural and Environmental Resources in the training of educators, managers and task force personnel to enhance climate science education and communication throughout the several programs and services offered by the agency

PROGRAM FOCUS AREAS: Environmental Literacy and Workforce Development; Resilient Communities and Economies

RELEVANCE: Puerto Rico's natural resources management practices were developed under relatively stable climatic conditions based on the presumption that ecological systems tend toward a natural equilibrium. However, management practices need to be re-examined due to the actual dynamic climate variability and changes. Natural resources educators have a similar problem and are expected to offer talks on climate change current issues to clarify and educate their audience about the importance of understanding the climate system.

RESPONSE: Puerto Rico Sea Grant developed a two-day climate change workshop for educators, managers and task force personnel (western zone) of the Puerto Rico Department of Natural and Environmental Resources. Specialists in climate change, geology, water quality, coastal processes, weather and marine ecosystems, collaborated in the field trip, to enhance communication of climate science and facilitate its integration into the agency's informal educational programs.

RESULT: Department of Natural and Environmental Resources employees (rangers, educators and resource managers) that attended the workshop expressed their willingness to apply the information, lessons and strategies learned to the agency's educational programs and services.

PARTNERS: Caribbean Integrated Coastal and Ocean Observing System (CarICOOS); Puerto Rico Department of Natural and Environmental Resources;

ASSOCIATED PROJECT(S):
MARINE EDUCATION (2018 - 2021)

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2018 Leveraged Funding

Project Level

Source	Project	Title	Amount	Type
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National Marine Fisheries Service (US DOC, NOAA, NMFS)	13194 - Marine Outreach Program (A/151-1-18)	SEAMAP-C	\$84,974.00	Managed
		TOTAL:	\$84,974	

Program Level

No Program Level Leveraged Funding for this year

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Performance Measures

2018 Communities implementing hazard resiliency practices

County of the Coastal Community	Name of Coastal Community	Number of Resiliency Training/Tech Assistance provided	Community hazard resiliency improved
Mayaguez	Mayaguez	6	Yes
San Juan	San Juan	6	Yes

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2018 Sea Grant Products - (tools, technologies, info services)

Description	Developed	Used
Actividad ciclónica en Puerto Rico y sus alrededores: 1867 al 2017. End users: First responders, Municipal and insular employees, general public and students. This publication resumes data regarding storms and hurricanes in PR within the last 150 years. Data from NOAA was used to identify distance from the shores of Puerto Rico.	Yes	Yes
Cartilla de los ciclones. End users: First responders, Municipal and insular employees, general public and students. This publication provides reference documents that includes among others: concepts and basics terms associated to hurricanes and storms information, nature, structure, meteorological conditions, intensity and associated dangers.	Yes	Yes
Fuete y Verguilla: Huracanado. End users: Fisherman and fisheries managers. Present experiences, reflections, information from fishermen and colleagues to document what happened during the hurricane and to offer alternatives to look into the future.	Yes	Yes
Revista Ambiental Marejada: Vol 16, Num 1 2018; Vol 16, Num 2 2018; Vol 15, Num 2 2017 and Vol 15, Num 1 2017. End users: Teachers, students, resources managers and general public. Environmental magazine committed to educate resources users about its conservation, sustainable development and applied research results.	Yes	Yes
Poster: Peces comestibles de Puerto Rico-Edible Fishes of Puerto Rico. End users: Fish consumers, restaurants, fishermen and fisheries managers. Educational tool to educate responsible fish consumers.	Yes	Yes

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2018 Economic (market and nonmarket) impacts

Description	Businesses Created / Retained	Jobs Created / Retained	Economic Benefit	Patents
	/	/		

2018 National Performance Measures - General

Performance Measure	Annual Target	Reported	Program Comment
Number of fishermen, seafood processing or aquaculture industry personnel who modify their practices using knowledge gained in fisheries sustainability and seafood safety as a result of Sea Grant activities	8,022	34	
Number of communities that adopt/ implement sustainable economic and environmental development practices and policies as a result of Sea Grant activities	216	14	
Number of acres of coastal habitat protected, enhanced, or restored as a result of Sea Grant activities	10,627	16	
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	1,161	2	
Number of people engaged in Sea Grant-supported informal education programs	815,294	148	
Number of Sea Grant-supported graduates who become employed in a job related to their degree within two years of graduation	244		

2018 Program Performance Measures

(No Data)

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2018 Metrics

Staffing Numbers	Individuals	SG FTEs	non-SG FTEs
Administrative	5.00	3.68	1.33
Communications	19.00	2.36	7.71
Education	5.00	1.98	1.89
Extension	10.00	4.62	1.98
Research	45.00	1.28	0.45

Core Funding	Proposals	Institutions Involved	From Home Institution
Pre-Proposals	23	16	2
Full Proposals	12	11	2
Proposals Funded	5	2	3

Student Support	Number of New Students	Number of Continuing Students	Number of Degrees Awarded
Sea Grant Supported Undergraduate Students	19	10	3
Sea Grant Supported MS/MA Graduate Students	7	7	1
Sea Grant Supported PhD Graduate Students	1	1	1
Other Sea Grant Supported Professional Degree Graduate Students	3	5	3

Other Metrics	Amount
VolunteerHours	1451
Number of P-12 Students Reached Through Sea Grant-Trained Educators or Directly through Sea Grant Education Programs	161148
Number of P-12 Educators who participated in Sea Grant education programs	979
SG-Sponsored/Organized Meetings/Workshops	58
Attendees in SG Meetings/Workshops	5220
Public or Professional Presentations	113
Attendees at Public or Professional Presentations	3336
Clean Marina Program -- Certifications	0
HACCP -- Number of people with new certifications	0