



**RUTGERS**

School of Environmental  
and Biological Sciences

# **2019** **RUCOOL**

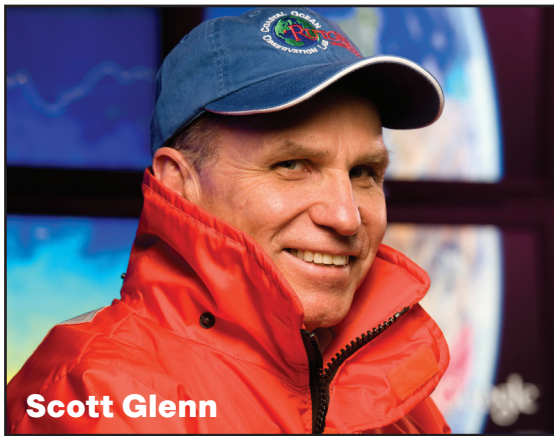
Center for Ocean Observing Leadership

**ANNUAL REPORT**



[rucool.marine.rutgers.edu](http://rucool.marine.rutgers.edu)





**Scott Glenn**



**Oscar Schofield**

## **Rutgers University Center for Ocean Observing Leadership**

(RUCOOL) is creating knowledge of our ocean planet by pushing the limits of science and new technologies while inspiring future generations of ocean explorers. We are an internationally recognized leader in interdisciplinary ocean research, education and societal outreach. The team's cutting edge research effort has always focused on innovating new ways to observe the ocean to rapidly advance our understanding of the ocean for the benefit of society. Currently RUCOOL is translating data collected by advanced ocean networks to improve hurricane forecasts, save lives by improving Coast Guard search and rescue, and to gain an understanding of how physical and chemical changes will alter ocean ecology. RUCOOL leverages academic, industry and government partnerships to lead interdisciplinary teams for New Jersey, the nation and the world.

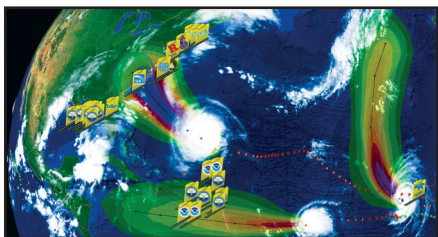
Today's students will be challenged over their professional lifetimes to provide society with 60% more food, 55% more water and 80% more energy for a growing global population forecast to exceed 9 billion by 2050. Our students will be required to meet this challenge while the climate is changing, sea level is rising, the ocean is acidifying, and extreme weather events are increasing. With focus spanning the K-12 education community, non-science and science undergraduate majors, graduate education and life-long learning around the world, RUCOOL implements a variety of programs and opportunities to support a workforce equipped to meet the challenge. These efforts are focused on hands-on learning supported by sustained real-time ocean research that translates the complex data into easily describable pieces that enable it to be used by diverse education communities. This year, to meet the needs of marine industry, we have initiated a new master's program for Operational Oceanography that provides a one-year immersion with hands-on training for modern tools needed by maritime employers.

RUCOOL's focus on discovering and communicating exciting ocean science is critical as a shifting climate and increasing human pressures alter our planet's ocean. RUCOOL is committed to developing the tools that will allow for the ocean's ethical and sustainable use.

**Scott Glenn**  
Distinguished Professor  
Co-Director, Center for  
Ocean Observing Leadership

**Oscar Schofield**  
Distinguished Professor  
Chair, Dept. of Marine and Coastal Sciences  
Co-Director, Center for Ocean Observing  
Leadership

## Improving National Hurricane Forecasts



RUCOOL collaborated with NOAA, Naval, Academic, and Industry partners to deploy over 62 ocean gliders to enable improvements to hurricane intensity forecasts at landfall. RUCOOL coordinated real-time data delivery from remote gliders to national repositories where the data were then assimilated into

operational ocean models used to forecast the intensity of Hurricanes Michael and Florence before landfall. Additionally, Travis Miles deployed an ocean glider off Jeju Island, South Korea that collected critical data as Typhoon Soulik passed over the glider. RUCOOL is using the data to evaluate how well the experimental and operational coupled ocean-atmosphere hurricane forecast models captured the reality. Results will inform efforts to develop a new United States hurricane forecasting capability.

## Offshore Wind Energy for New Jersey

One of Governor Murphy's first actions as governor was to begin the development of offshore wind for NJ. Working with state agencies, RUCOOL has used its in-house RU-WRF atmospheric model to evaluate the offshore wind resource for NJ, and made this data publicly available for all interested stakeholders. Additionally, RUCOOL has worked closely with the team developing NJ's Offshore Wind Strategic Plan, providing data, scientific expertise, and assisting with public meetings. RUCOOL continues to bring the important message that the best science will lead to ensuring offshore wind is developed in such a way that incorporates the needs of all ocean users.



## Offshore Wind Research with Developers



RUCOOL has led Rutgers' drive to collaborate with offshore wind developers operating here in NJ, and has hosted visits and discussions with all three developers in the NJ market (Ørsted, Equinor, and EDF/Shell). To that end, Rutgers has already signed Memorandum of Understanding with Ørsted, who are developers of the Ocean Wind project off of Atlantic City, and EDF/Shell, who are developing the Atlantic Shores project also off of Atlantic City. These MOUs allow RUCOOL to collaborate with developers on a variety of projects, including marine mammal monitoring and improved wind resource assessment and modeling, and also allow for future work throughout Rutgers. Ørsted recently won approval from NJ for an 1100 MW wind farm to be built in its Ocean Wind lease area, and NJBPU will be soliciting an additional 1200 MW of capacity in 2020.

## Changing Climate at the Bottom of the World

RUCOOL anchors the NSF funded Palmer Long Term Ecological Research program, which is conducting a long term study of how a changing climate will impact polar marine ecosystems along the West Antarctic Peninsula (WAP). The WAP is the fastest warming winter location on Earth. RUCOOL has documented major changes in the food web which is being driven by a changing ocean. The changes have impacted the base of the food web and declines in the penguin populations. This year we conducted our 28th year of data collection at Palmer Station and during a 6-week cruise along the WAP. The team pictured in the photo collected a wide range of data spanning plankton, krill, and foraging dynamics of penguins and whales. Planning is already underway for the 2020 field season.



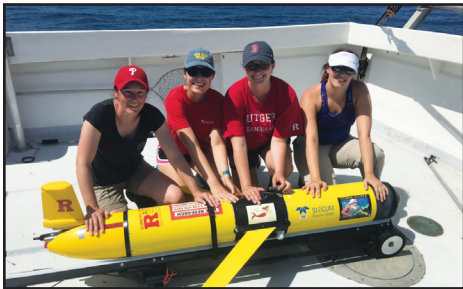


## Antarctic Ecosystem

RUCOOL is investigating the Ross Sea food web through integration of acoustic and AUV technology. An Acoustic Zooplankton Fish Profiler (AZFP), was integrated into a Slocum glider, and was deployed by Grace Saba's field team in Terra Nova Bay, Antarctica, in 2018, to map the distribution and abundance of multiple zooplankton and silverfish. Data revealed copepods, larval silverfish, and pteropods dominating shallow depths (50-125 m), while the abundance of crystal krill increased at depths. High-resolution glider measurements of these key species and the oceanographic environment improve our understanding of this productive Antarctic ecosystem. Ultimately, we will collect high resolution glider-based acoustic measurements that will pave the way for cost-effective, automated examination of entire food webs and ecosystems all over the global ocean.



## First glider-based pH platform developed for ocean acidification (OA) monitoring



RUCOOL deployed the first glider with integrated pH sensor for observations of ocean acidification in coastal ocean systems, demonstrating the ability for gliders to routinely provide high resolution water column data that can be applied to OA monitoring efforts on regional and national scales through glider networks.

## R/V Rutgers: Mobile Teaching Lab



The R/V Rutgers has been used extensively for scientific fieldwork and various educational programs, from core classes to community outreach and volunteer training. Over 40 cruises were completed this year, hosting 390 passengers.

A shallow draft and bow ramp allows for easy access to marshes and shorelines for embarking/debarking, water and/or sediment sampling, or even deploying AUV's such as RUCOOL's Slocum gliders. The R/V Rutgers has a suite of oceanographic instrumentation including current meters, water quality samplers, and phytoplankton and microplastics sampling equipment. Several new additions have added the ability to sample water at specified depths and map bottom features, making the vessel an ideal platform for both science and educational purposes.

## Faculty Award

### 2018 Ocean News & Technology/MTS Young Professional

Travis Miles was the 2018 Ocean News and Technology/Marine Technology Society Young Professional. This award recognizes an MTS Member, 35 years old or younger, who has demonstrated leadership in MTS and work in a professional capacity in management, engineering or research and development in a marine technology field. Miles was selected based on his work adapting autonomous underwater gliders for use in hurricane intensity research. The use of these systems has enabled new understanding of

how our coastal oceans can intensify or weaken hurricanes in the critical last hours before landfall. This work has led to the enhancement of coastal ocean observing networks across the eastern US, Gulf of Mexico, and Caribbean Sea. In addition to research, Miles has contributed numerous papers to the MTS journals, regularly supported student engagement, and developed a new MTS summer course on glider training at Rutgers.

## Investigation of Microplastics in the Raritan Bay food web



Plastics, observed frequently in seawater, are emerging contaminants in the global marine environment with the potential to enter the human food chain. Coastal rivers are considered an important entry point for land-based sources of microplastic debris in coastal environments. New Jersey Sea Grant is funding Grace Saba at RUCOOL and other Rutgers partners to research the issue in our rivers. We are investigating the potential ingestion of microplastics by common zooplankton in Raritan Bay and whether frontal systems from river plumes are associated with microplastic aggregation and increased ingestion by these animals.

## Protecting the Gulf of Mexico

Rutgers, Texas A&M, the University of South Florida, and the University of Southern Mississippi are partnering to support the National Academies of Sciences Gulf Research Program. The project seeks to enhance offshore energy system safety and protect human health and the environment by catalyzing advances in science, practice, and capacity to generate long-term benefits for the Gulf of Mexico region and the nation. The Gulf Research Program seeks to support activities that will supply new observations, analyses, and modeling needed to advance our understanding of Loop Current dynamics for the purpose of improving predictive skills of the Loop Current and associated eddies. Rutgers will be working with the soon-to-be-installed HF-Radar systems in the Gulf, that are going to better enable us to measure surface currents over enormous areas, which will improve ocean forecast models, thereby improving search and rescue and oil spill response in the Gulf.

## MACAN

Mid-Atlantic Coastal Acidification Network (MACAN) efforts produced two peer-reviewed publications and a stakeholder outreach survey (Grace Saba, MACAN co-coordinator; funded by the NOAA Ocean Acidification Program): Two Mid-Atlantic coastal and acidification-related manuscripts were recently published and are currently in press with Estuarine, Coastal, and Shelf Science. Additionally, to gain a better understanding of potential industry impacts and concerns related to coastal and ocean acidification, MACAN developed and distributed Qualtrics surveys tailored toward six specific industries. These surveys are now closed, and data analysis is currently underway.

## Safety at Sea



RUCOOL is working on several projects to improve safety of life at sea. For ten years, Rutgers has been providing surface current measurements to the US Coast Guard for their search and rescue missions through our NOAA Integrated Ocean Observing System project. These measurements are assimilated into a forecast models to predict the drift track of people and boats. The Rutgers model ranked first among 15 different products used for planning search and rescue operations. The RUCOOL radar was the 4th most recommended product.

RUCOOL is also working on integrating unmanned aircraft systems (UAS) into lifesaving operations. The cities of Long Branch and Belmar, NJ, have expressed interest in utilizing UAS in their lifeguard operations. The potential applications they foresee are delivery of flotation to a victim, detection of



submerged victims, detection of sharks in the area, communicating with victims and use of UAS in long-range rescue far from shore.

## Fisheries

RUCOOL laboratory experiments measuring metabolism of black sea bass and spiny dogfish at a range of temperatures were recently completed. A paper focused on the black sea bass fishery was recently published by Emily Slesinger (student) and Grace Saba that describes a decline in the performance of oxygen demand processes at temperatures above 24C. The temperature curves determined in these laboratory experiments are currently being used to produce habitat suitability models that will inform projections of black sea bass habitat in future, warmer Mid-Atlantic shelf waters.





## The Blue Economy and our future leaders



RUCOOL is focused on developing a next-generation workforce to tackle the challenges and opportunities tied to a growing

blue economy. RUCOOL has launched the new Masters of Science in Integrated Ocean Observing, welcoming its inaugural class in July 2019. These students will be challenged over their professional lifetimes with providing 60% more food, 55% more water and 80% more energy to support a growing global population predicted to exceed 9 billion people by 2050. Sustainable solutions that provide for basic human needs, minimize climatic impacts, and build resilient societies will require increasingly efficient green and blue economies on land and at sea. Our incoming students are engaged, prepared, and excited to learn and become leaders in this critical sector.

## Training the Future Science Generations



RUCOOL is delighted to partner with the Marine Technology Society to offer an annual technology camp focused on underwater gliders. This past June we hosted a week-long, hands-on experience using underwater glider technologies. The Marine Technology Glider Camp is designed to offer students a chance to not only learn about underwater gliders, but also deploy the equipment to gather data applied to various scientific investigations.

## Faculty Award Hutchinson Award

Dr. Oscar Schofield is the 2019 recipient of the G. Evelyn Hutchinson Award. He was cited for transforming our understanding of the physical and chemical processes that govern marine phytoplankton physiology and ecology through the application of novel ocean observing tools, and for his skillful and enthusiastic leadership of the collaborative science necessary for addressing broad scale oceanographic challenges. Schofield has held key leadership roles in the community, chairing and serving on national and international steering committees for ocean observatories. He is regarded in the field as an enthusiastic and inspirational mentor, collaborator, and spokesperson for oceanography.

American Society of Limnology and Oceanography President Michael Pace said, "The Hutchinson Award emphasizes quality and innovation – two words easily applied to Schofield's body of work. Through his contributions to methodologies and his leadership in the field, Schofield's work will pave the way for many more discoveries. Schofield is richly deserving of this honor."




## Cook Campus Became the Center of the Underwater Glider Universe

The European (EGO) and US (UG2) Autonomous Underwater Glider User Groups came together to host the 8th EGO Meeting and International Glider Workshop at Rutgers, May 21-23. The meeting provided a forum in which scientists, engineers, students and industry from 17 countries could exchange knowledge and experiences on the development of glider technology, the application of gliders in oceanographic research and the role of gliders in ocean observing systems.


# EDUCATION

  
**>500**  
VISITORS per year

  
**10**  
GRADUATE STUDENTS annually

**\$7.123**  
MILLION in funding per year  


**26**   
**ACTIVE AWARDS**  
(grants, donations, cooperative agreements)

**>150**   
**UNDERGRADS** taught per year

**NOAA**  
**\$8.0M**  
National Oceanic and Atmospheric Administration

**NASEM**  
**\$310k**  
National Academy of Sciences, Engineering and Medicine

**COL**  
**\$2.2M**  
Consortium for Ocean Leadership

**Foundations**  
**\$210k**  
Vetlesen and Mistletoe

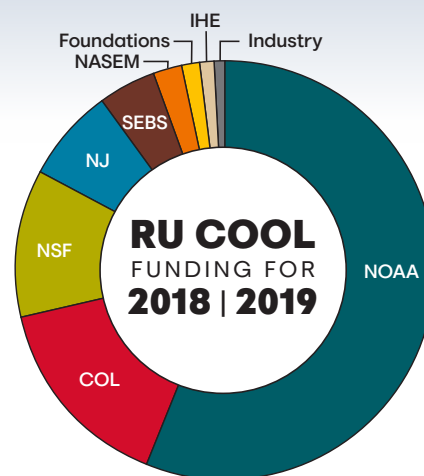
**NSF**  
**\$1.63M**  
National Science Foundation

**IHE**  
**\$130k**  
Institutes of Higher Education

**NJ**  
**\$1.63M**  
State of New Jersey

**Industry**  
**\$115k**  
Teledyne Webb Research

**SEBS**  
**\$1.63M**  
School of Environmental and Biological Sciences



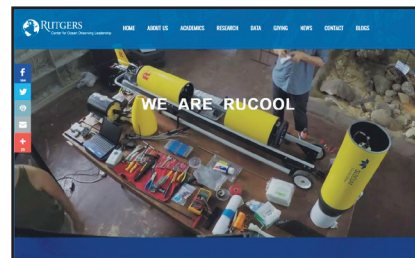
## Our visitors are pretty COOL

RUCOOL hosts numerous groups, tours, visitors and researchers every year. Over 500 people visited COOL over the last year, including ages ranging from 9 to 90. These included elementary school students, Middle school students, high school students, college undergrads and grad students, international visitors from over 30 countries, researchers from around the country, and of course, many people from around the state of New Jersey. We will continue to share our knowledge of the science of the ocean for the years to come.



## The new RUCOOL website

RUCOOL updated our entire website to welcome the newest generation of students, researchers, and the public. This new user-friendly face of RUCOOL has generated an increase in web visits by 50% over the previous year. Please visit [RUCOOL.marine.rutgers.edu](http://RUCOOL.marine.rutgers.edu) to learn more about us, review the latest real-time data from our oceans, catch up on the latest news, and peruse the COOL research going on in our lab.



[rucool.marine.rutgers.edu](http://rucool.marine.rutgers.edu)

Department of Marine and Coastal Sciences  
School of Environmental and Biological Sciences  
71 Dudley Road  
New Brunswick, NJ 08901-8520

## RUCOOL's MISSION

RUCOOL is creating knowledge of our ocean planet by pushing the limits of science and new technologies while inspiring future generations of ocean explorers, with four core focus areas:

### LEADERSHIP IN OCEAN SCIENCE

Focused on understanding the underlying processes that impact our ability to predict marine systems through the integration of observing and modeling technologies.

### DEVELOPING A BLUE ECONOMY

Provides comprehensive ocean and atmospheric data supporting business and local-state-federal agencies to ensure smart and sustainable use of the coastal Mid-Atlantic, including operating a real-time weather model since 2011 for offshore wind resource assessment.

### EXTREME OCEAN ENVIRONMENTS

Studying the most extreme ocean environments on Earth, spanning typhoons to ice-covered seas. This includes exploring the vital air/sea connections that drive hurricanes and coastal storms here in the Mid-Atlantic.

### EMPOWERING THE NEXT GENERATION

Innovating education practices to enable all humanity to be active explorers of their ocean planet, including a recently launched Masters of Integrated Ocean Observing program to further support this mission.

