VIRGIN ISLANDS EPSCoR

FALL 2019

Mare Nostrum Caribbean

Stewardship Of U.S. Virgin Islands Resources
Through Strategic Research And Workforce Development

Contents

"In reflecting back over the past two years, I have never been more impressed by the collective resolve and dedication to recover and rebuild as I have with the citizens of the Virgin Islands, particularly the students, faculty and staff here at the University of the Virgin Islands. This issue of our newsletter is dedicated to them."

– Kim Waddel, Ph.D.,

Reflections

Here at VI-EPSCoR, we just completed our 5th year of research and supporting capacity building activities under our NSF-EPSCoR RII Track 1 grant titled *Mare Nostrum*. In developing the theme for this newsletter issue, we thought that this would be an appropriate time to reflect over the past five years and highlight the accomplishments and scientific advances made by our researchers, students and staff. We also wanted to acknowledge the challenges during this grant cycle—most notably the two Category 5 hurricanes that devastated the USVI, our neighbors in Puerto Rico, and other northeastern Caribbean islands in 2017—that stunned us all but in the long run made us more determined, resourceful and in some ways, more resilient.

The dominant research thrust supported by VI-EPSCoR continues to be our research exploring the diseases, diversity and demographics of coral reefs led by Drs. Marilyn Brandt, Rick Nemeth, and Tyler Smith. Brandt's team has been studying the sources and mechanisms of coral disease transmission – specifically the diversity of pathogens and other microbes collectively known as the "microbiome" that live within the corals. She and her students have learned much about the complex interactions between environmental stressors such as higher sea temperatures and land based pollutants such as sediments and excessive nutrients with the corals. All this work has prepared Brandt and her colleagues to tackle the latest threat – a new rapidly spreading disease identified as "stony coral tissue loss disease" that recently devastated the corals in the Florida Keys and has been discovered off the south side of St. Thomas. Brandt has drawn upon an active network of colleagues and students to help galvanize a multipronged research response to understand, predict and potentially control this and other diseases that are challenging our coral reef ecosystems.

While corals are important part of a large complex marine ecosystem that stretches from nearshore shallow waters to over 300 foot depths, they are interdependent with a variety of species including fish and turtles that play a variety of roles from algae & grass grazers to predators in this ecosystem. VI-EPSCoR investments in acoustic transmitters allow our researchers and students to track the movement of these species in order to help understand their behavior and roles within this ecosystem.

We also have come to realize that the rate of change and challenges impacting the marine ecosystem require more than just observation and understanding in order to manage these natural resources that are foundational to our tourism-based economy. This is especially true after the 2017 hurricanes, but also considering the impacts of more chronic stressors such as rising sea temperatures and land-based pollution. With Dr. Brandt's leadership, our coral restoration technicians are leading the efforts behind VI Reef Response – reflecting a growing partnership between UVI, local dive shops, and engaged citizen scientists—to build and expand the number of sites dedicated to reef restoration.

VI-EPSCoR investments have also improved our ability to understand the factors that influence ocean temperatures and their impacts on the ecology of marine life here in the Caribbean- using sophisticated technical deep diving teams and a variety of monitoring buoys and tools. Dr. Tyler Smith led this research, and his work and publication record in this area of research led to his appointment to a prestigious U.S. National Academies of Sciences' committee tasked with identifying interventions that scientists can apply to increase the persistence and resilience of coral reefs around the world.

One of the key stressors in our coastal and marine ecosystems are our land-based sources of pollution. Dr. Kristin Wilson Grimes, her lab team, and over a hundred volunteers gave Virgin Islanders a sense of just how much marine debris can accumulate in just one year in just one marine reserve among the mangroves of southeastern St. Thomas Island. They removed over 1700 pounds of predominantly plastic debris during the second annual "Great Mangrove Clean-Up". This effort, supported by a NOAA grant and support from the VI Marine Advisory Service and VI-EPSCoR, has led to the development of a Marine Debris Action Plan that will guide marine debris prioritization and removal from all three islands in the USVI over the next few years.

All of our VI-EPSCoR research, education, and workforce development efforts simply could not be accomplished without our graduate and undergraduate students. While our students in the master's in Marine and Environmental Science program contribute much to the enterprise, we are particularly excited to see a subset of those students get opportunities to explore the possibilities of advanced degrees like a Ph.D. Drs. Wilson Grimes and Brandt received a National Science Foundation grant that has been augmented with additional support from a local foundation and the US Environmental Protection Agency to provide a bridge to PhD programs targeting underrepresented minorities. To date, eleven students have participated, and we expect to continue introducing more UVI students to these opportunities.

Among the many roles that public universities play in society, one routinely includes preparing the future workforce who can then tackle the opportunities and challenges facing their communities and the nation. Under the *Mare Nostrum* grant we have directed our energies in several key areas. Nationwide, Science, Technology, Engineering and Mathematics (STEM)-educated workers are in high demand, and the need is just as great here in the Territory. Our investments have been dedicated to improving STEM education through Grades K-12 teacher professional development, mentoring new UVI STEM faculty, and developing UVI undergraduates for enhanced recruitment and retention in the STEM fields. We also believe education and improving science literacy can be facilitated in informal and nontraditional settings, so our Education, Outreach, and Diversity team have contributed much to our program by raising our profile in the community as well as fostered collaborations with NGOs, local businesses, schools and foundations –all to enhance the effective communication of how science and research are relevant to the present and future Virgin Islands.

The articles shared in this issue highlight the many remarkable accomplishments of the *Mare Nostrum* project. I hope you enjoy and learn something new about our work here in the USVI!

Dr. Kim Waddell, Director

Coral Reef Disease, Diversity & Demographics

By Richard Nemeth, Ph.D., VI-EPSCoR Senior Scientist and Paul Jobsis, Ph.D., Director of the Center for Marine & Environmental Studies

This Nassau Grouper has been tagged with an acoustic transmitter so researchers can follow its movements and learn more about its spawning behaviors. Photo: R. Nemeth

Acoustic transmitters emit unique signals that travel up to 300 meters underwater. When a receiver detects the signal from a tagged animal, it records the date, time and identification number of the animal. This information is stored until the receiver database is downloaded.

Acoustic receivers have been strategically placed around research locations such as Brewers Bay, St. Thomas and St. Croix East End Marine Park.

Mare Nostrum Investments Revolutionize UVI Research

Our knowledge of animal movements in the marine environment has greatly increased through the support of the VI-EPSCoR program. Over several years, nearly 150 fish, representing 34 species and 22 fish families, and 30 endangered/threatened sea turtles, representing two species, have been tagged with acoustic transmitters, which allowed University of the Virgin Islands (UVI) researchers to track the animals' movements using moored receivers.

Multiple projects, addressing specific research hypotheses, have included the study of parrotfish foraging behavior in Bermuda, small-scale movements patterns of the invasive lionfish on shallow and mesophotic reefs (St. Croix and St. Thomas), reproductive behaviors of the endangered Nassau grouper (St. Thomas), the relationship of marine managed area boundaries to fish movements (St. Croix), and the effects of habitat, environmental variability, and hurricanes on movements of sea turtles and a variety of commercially important reef fishes (St. Thomas).

This work has engaged a large number of UVI students and faculty and resulted in eight master's theses, 12 presentations at international conferences and another nine publications that are currently in press or preparation.

Several of these projects are still underway and data has not yet been fully analyzed. However, we have already learned much about the animal movements. For example, tagged green and hawksbill turtles found in Brewers Bay, St. Thomas, have relatively small home ranges, much less than a square kilometer, and many of these individual turtles remained in the area for at least four years.

Of the other projects, we have learned that some animals (sea turtles and some species of fish), but not all, respond strongly to approaching hurricanes by retreating to deeper water. Post-hurricane, most tagged animals returned to their normal home range, but some (stingrays, grouper, triggerfish) left their home range after a few days or weeks and never returned. The departure of stingrays, in particular, was probably the result of storm surge disturbing their primary feeding habitats of seagrass and sand.

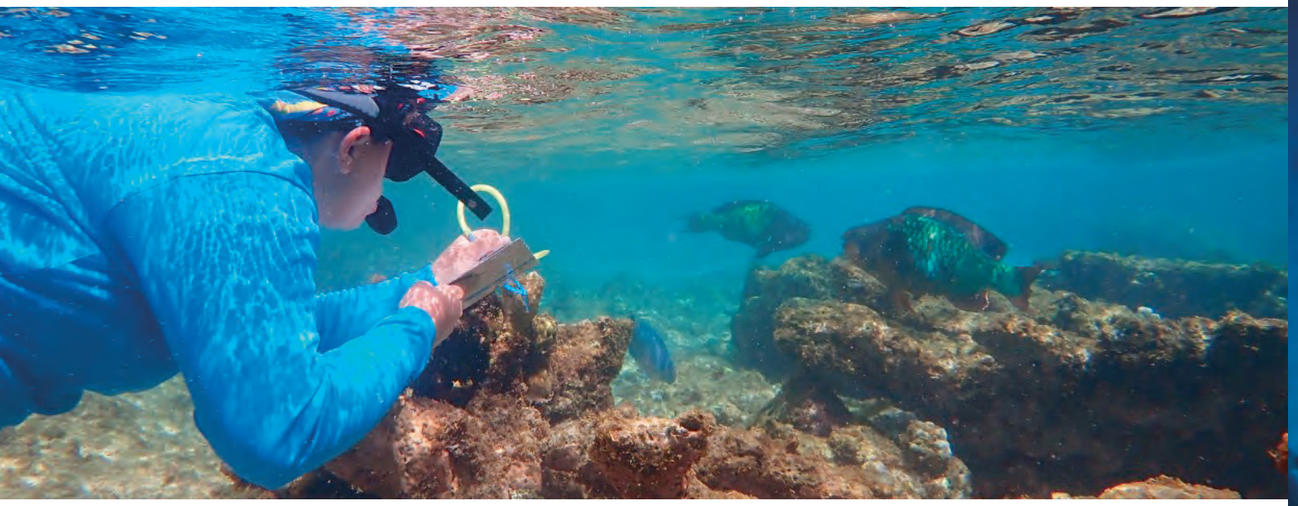
We also found evidence that increasing seawater temperatures can make animals use different home ranges. For example, the Atlantic tarpon typically shelters in shallow lagoons at night except when seawater temperature exceeds 29° C. Then the tarpon rest in deeper, cooler waters, but the trade-off may be greater risk of predation. This information will allow us to make predictions about future animal movements under different climate change scenarios when the tropical Atlantic may experience warmer waters and more severe hurricanes.

When we tagged the invasive lionfish, we learned that lionfish living in patch reef habitats had larger home ranges than lionfish in contiguous reef habitat, suggesting that lionfish may need to forage over larger areas when living on patch reefs. While the majority of lionfish moved less than 500 meters, some moved more than three kilometers away from where they were tagged in shallow water less than 15 meters deep, to mesophotic reefs 45 meters deep. We found that biomass of potential lionfish competitors and predators greater than 13 cm, negatively influenced lionfish residence on sites.

This suggests that healthy native fish populations may have a negative influence on invasive lionfish. Understanding the drivers of lionfish habitat use is crucial for the management of this invasive species and can lend better insight to identify high-risk reef habitats of lionfish invasion.

By Amanda Long, MMES Candidate in the Nemeth Lab

MMES Candidate Studies Parrotfish Feeding Rates



As a second-year Masters of Marine and Environmental Studies in the Nemeth Lab, I am researching the feeding rate of four species of large *Scarus* parrotfishes, the Rainbow (*S. gaucamaia*), Midnight (*S. coelestinus*), Blue (*S. coeruleus*) and Queen (*S. vetula*). My research primarily looks at the effect of latitude on herbivory by comparing the feeding rates of these same species in Bermuda (32.3078 N, 64.7505 W) and Bonaire (12.2019 N, 68.2624 W).

This summer, a team of researchers including myself, Dr. Richard Nemeth and Sarah Heidmann, traveled to Bonaire to collect data for this project. While on location, we conducted 20-minute "fish follows" to record herbivory data including number of bites, type of food eaten, substrate, defecations, and interactions with other fish. We also collected algae abundance data at each site. In total, 87 parrotfish from three different sites around Bonaire were followed. This data will be compared to earlier herbivory data collected in Bermuda in 2016, 2017, and 2019.

Additional data collection following the same procedures are conducted monthly at Flat Cay just south of St. Thomas, Virgin Islands, to measure the seasonal effect of temperature change and algae abundance on the feeding rate of *S. vetula* the Queen parrotfish. All of the collected data will help this project reach the goal of better comprehending the role that herbivores play in reducing the amount of algae on reefs and opening up space for coral recruitment. Large parrotfish are important herbivores, but the specifics of how the Rainbow, Midnight, Blue and Queen parrotfish contribute to algae reduction is not fully understood.

Ultimately, this research project seeks to better understand the differences between the feeding rates of four parrotfish species and how latitude effects these rates. This information will potentially help inform managers how best to set fishing restrictions in the Caribbean and help keep important herbivores on coral reefs, thus keeping algal growth at bay.

Above: Amanda Long recording feeding behavior of a rainbow parrotfish in Bonaire .

Right: Blue parrotfish seen feeding over sandy substrate in Bonaire.

Photo: S. Heidmann

By Marilyn Brandt, Ph.D., Research Associate Professor of Marine and Environmental Science

Coral disease has become an increasingly important source of coral loss on coral reefs worldwide. With assistance from VI-EPSCoR funding, Dr. Marilyn Brandt's laboratory in the Center for Marine and Environmental Studies (CMES) at the University of the Virgin Islands (UVI) has been tackling the challenge of understanding coral disease in a rapidly changing environment.

The Brandt Lab Leads In Coral Disease Research

One of the greatest challenges facing scientists studying coral disease is the difficulty in identifying pathogens. The complexity of corals is extraordinary. Corals have a critical symbiotic relationship with small plants that live in their tissues. The extra nutrition that the plants provide to the corals by photosynthesizing allows them to grow their skeletons and create coral reefs. But new research is revealing the corals also have other relationships with bacteria, fungi, and possibly even viruses that live in their mucus, in their skeletons, and even in their tissues, and these relationships are just as important to the coral's survival and growth. All of these microscopic critters make up the "microbiome" of the coral. Scientists are finding that the microbiomes of corals can vary across species, regions, and even time periods. Therefore, it is like aiming at a moving target to try and understand what a coral's microbiome is. This makes identifying pathogens or unhealthy microbiomes extremely difficult.

Not knowing the pathogen of a disease can hinder the ability to understand risk factors and disease transmission, ultimately impacting our ability to predict and control disease.

Nevertheless, even when some pathogens have not been identified, Brandt believes much still can be learned about coral disease. She and her students have gained significant insight into critically important aspects of coral disease, performing experiments in the environment and using seawater tables at CMES, with the hope that their work will help managers and restoration specialists to conserve reefs.

Over the last five years, Brandt's lab has identified transmission mechanisms and distinguished risk factors associated with the important coral diseases white plague and black band. These Caribbean coral diseases affect multiple species of corals, and when outbreaks of these diseases occur, they can cause devastating losses of coral. Brandt and her students identified water transport as an important mechanism of transmission and determined what species of corals were most susceptible to infection.

With travel support from VI-EPSCoR, Brandt was able to present these results at the 2016 International Coral Reef Symposium, which led to securing a collaborative NSF EAGER grant with Dr. Laura Mydlarz's laboratory at the University of Texas, Arlington and Dr. Erinn Muller at Mote Marine Laboratory. The transmission work that was led by Brandt at UVI with samples being analyzed by Mydlarz and Muller led the identification of important immune components that cause the differences in disease susceptibility among coral species.

Above, Dr. Brandt works closely with Naomi Huntley, MMES candidate, on a coral specimen.

Below, Dr. Brandt monitors the water tables at CMES. Photos provided by M. Brandt

Brandt's lab is well positioned to assist in the response to the emergence of stony coral tissue loss disease in St. Thomas in January, 2019. This disease has been ravaging the reefs of the Florida Keys for 5+ years.

VI-EPSCoR-supported Post-doctoral Associate Dr. Andia Chaves-Fonnegra worked with Brandt for two years and together they identified important environmental drivers of white plague disease. They did this by analyzing a temporally and geographically rich data set collected by Brandt's laboratory in the previous three years, revealing for the first time that turbidity as well as temperature can be a driver of disease. These results suggest a potential role for terrestrial run-off in triggering increases in disease.

Dr. Chaves-Fonnegra completed her post-doctoral work and went on to become an assistant professor at Harbor Branch Oceanographic Institute where she was recently named a 2019 Early Career Research Fellow in the National Academies' Gulf Research Program.

All of this work put Brandt's lab in a good position to assist in the response to the emergence of stony coral tissue loss disease (SCTLD) in St. Thomas in January of 2019. SCTLD is a newly identified coral disease that affects up to 22 species of corals and has been ravaging the reefs of the Florida Keys for more than five years. Brandt's lab identified the disease early in its emergence in the US Virgin Islands and has been tracking its spread and performing experiments to determine its transmissibility and impact on Virgin Islands coral reefs.

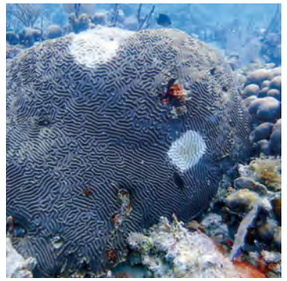
Brandt became the lead on collaborative work funded by an NSF RAPID grant to identify microbial properties of the disease and coral immune responses. The effort includes collaborators at Woods Hole Oceanographic Institute, University of Texas, Arlington, Rice University, Louisiana State University, and Mote Marine Laboratory.

Brandt's lab also has partnered with VI-EPSCoR and the Division of Coastal Zone Management of the US Virgin Islands Department of Planning and Natural Resources to launch an aggressive communications campaign and citizen science program focused on the emergence of SCTLD. Communications have included multiple articles in local and national press, appearances on local radio stations, and numerous community events.

Brandt's lab recently received NOAA funding to execute a disease response coordination workshop that will invite scientists and managers from around the US Virgin Islands and Puerto Rico to work on coordinating efforts to study the disease.

VI-EPSCoR has supported Brandt's laboratory by providing funding for student research assistantships and student experiments. Over the last five years, VI-EPSCoR has provided partial or full support for eight of Brandt's previous and current graduate students in the UVI Master of Marine and Environmental Science program, five undergraduate students, and two local high school interns. Among the students who have worked on projects and experiments related to coral disease are Logan Williams (M.S. 2017), now the education and outreach coordinator for Coral World on St. Thomas; Danielle Lasseigne (M.S. 2018), who will begin as a technician with the Gulf Breeze laboratory of the Environmental Protection Agency in October 2019; Lauren Olinger (M.S. 2017), now a Ph.D. student at the University of North Carolina Wilmington; and Jendahye Antoine (B.S. expected 2020), who was awarded a NOAA EPP/MSI Scholarship for 2018-2020.

The Progression Of A Deadly Coral Disease



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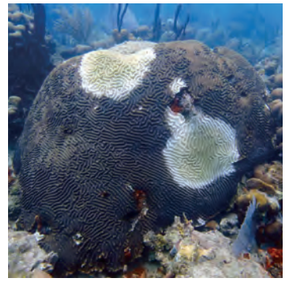

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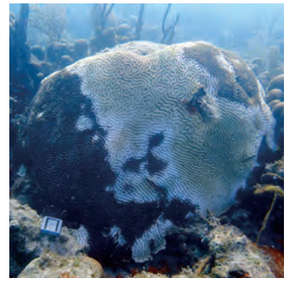


February 21, 2019

March 6, 2019

This large colony of coral (1.4 meters wide) experienced full mortality in just over one month. The white patches are exposed skeleton where, what we believe to be, stony coral tissue loss disease has necrosed the coral's tissue.

VI-EPSCoR -supported MMES student, Sonora Meiling researches coral disease.

Sonora Meiling is a second-year graduate student in the Masters of Marine and Environmental Science program working under Dr. Marilyn Brandt as the VI-EPSCoR disease research assistant. Since Stony Coral Tissue Loss Disease was discovered in waters off of St. Thomas, Meiling has been working in the field and in the lab to describe this novel disease.

One component of her thesis includes a transmission experiment that exposed healthy colonies of coral to diseased colonies in order to document the susceptibility, incidence rate, and lesion progression rate for six important reef-building species. In order to validate her results, she is building 3D models of marked corals on the reef weekly for photogrammetry analyses of the lesion progression rate. Early this fall, she plans to conduct another transmission experiment to better address the transmissibility of the SCTLD pathogen through water by exposing healthy corals in the lab to water taken from the reef above a diseased coral.

Sonora Meiling taking photos of the corals in the disease transmission experiment. This was repeated twice daily to monitor the health of the fragments in order to analyze species susceptibility and lesion progression rate of what we believe to be stony coral tissue loss disease.

Photo: Amanda Long

By Alexandra Gutting – MMES Candidate in the Brandt Lab

VI Reef Response

After category five hurricanes Irma and Maria devastated St. Thomas in 2017, VI-EPSCoR coral restoration interns Kristen Ewen and Alexandra Gutting set out to survey the damage to a reef at Flat Cay just south of the island.

What the interns found at Flat Cay was disheartening – a previously thriving and diverse reef had been largely reduced to rubble. Despite the damage, a closer look at the reef gave them reason to be hopeful. Many of the broken coral fragments scattered across the ocean floor were still alive – and could survive and flourish in a coral nursery setting, and eventually be planted back to the reef, allowing the reef to grow and thrive once more. The interns were excited about the idea but knew it would be impossible for them to restore the reef without help…thus, the Virgin Islands Reef Response was born.

VIRR is a coral conservation citizen science program lead by principal investigator Dr. Marilyn Brandt that was created to help make a coral restoration program possible at UVI. Constructing, stocking, and maintaining a coral nursery takes a lot of work, and is especially challenging since much of the work needs to be conducted on SCUBA. VIRR offers an opportunity for St. Thomas residents and visitors to become citizen scientists and learn about coral reefs and coral restoration while assisting with nursery construction, maintenance, and data collection. VIRR first enlisted the help of citizen scientists to construct coral nursery structures, called coral 'trees,' on which to hang the coral fragments. The call for help was answered by two groups – the Youth Ocean Explorers and voluntourists (cruise ship vacationers who complete a volunteer project at each stop).

Once the trees were in the water and coral fragments attached, VIRR teamed up with two local dive shops, Red Hook Dive Center and Admiralty Dive Center, to assemble teams of divers to keep the coral trees clean and the corals healthy. If the trees are not cleaned regularly, algae quickly grows on them and can overgrow corals, blocking out the light that they need to survive and thrive.

Each coral tree can take almost an hour to clean – an entire dive. Maintaining ten coral trees with just two people would mean the dive buddy team would need to dive for five hours each time the nursery needed to be cleaned! The inaugural VIRR team cleaned all ten trees in just one hour.

Since then, VI Reef Responders have continued to help maintain the coral trees and have also taken data on the health and growth of coral fragments in the nursery. More recently, they have begun to survey local reefs for the presence of a newly emerged coral disease (thought by coral disease experts to be stony coral tissue loss disease) and have been a huge help to UVI coral disease scientists in mapping the disease.

In addition to hosting dives open to the public, VIRR and its partner dive shops have hosted dives for high school students. These students began their marine studies in the Youth Ocean Explorers program, became dive certified in the Coki program, and are now conducting science on SCUBA!

So far, VIRR has received assistance from about 100 citizen scientists, who have assembled 20 coral trees, cleaned 40 coral trees, collected data on 360 coral fragments, and surveyed four reefs for the presence of stony coral tissue loss disease.

VIRR dives have been positive experiences for the citizen scientists and have fostered feelings of stewardship for our local reefs.

"Through this program, hobby divers have learned about corals, their threats, their successes, and the overall reef ecosystem. I believe that this knowledge will expand into more coral reef conscious divers who will continue to spread awareness about the delicate balance of the Virgin Islands reefs," said Adrianne Poe, a dedicated citizen scientist who has participated in all of VIRR's dives to date.

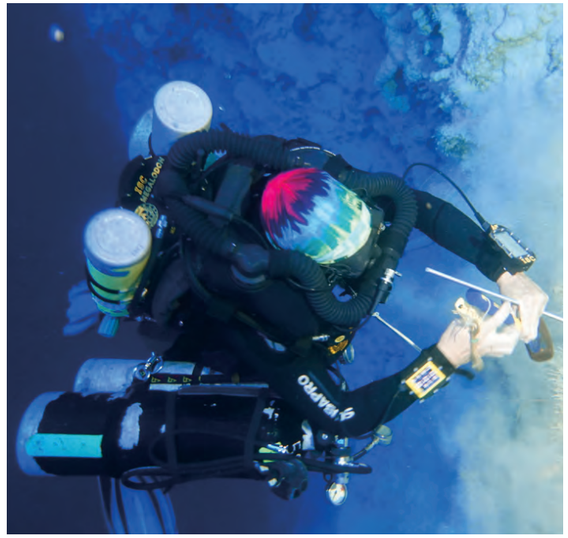
VIRR also has big plans for the future. With the help of VI Reef Responders, VIRR will plant corals back to the reef in spring of 2020, expand the Flat Cay nursery to include new types of coral tree structures, and install a new coral nursery on the east end of St. Thomas.

Junior SCUBA divers have been active citizen scientists through their participation in the Reef Response Program. Above from left: Anushka Chandiramani, Maia Aqui, Captain Jerry Cowan, Sakari Clendenin, Alex Gutting, Kyle Jerris, Paschal Bryan and Diego Villegas.

Below, Sakari and Maia work together to remove algae from a coral tree. This work is important because algae can quickly overgrow corals, blocking out the light that corals need to survive and thrive. Photos: A. Gutting

By Tyler Smith, Ph.D., Associate Research Professor of Marine Science

Five Years of Improved Infrastructure Supports Ocean Warming Research



Dr. Tyler Smith installs a stake to support a temperature probe at 330' in Cane Bay, St. Croix. Probes were also installed at Salt River and the southeastern Lang Bank (November 5, 2018; Photo: V. Brandtneris)

One purpose of *Mare Nostrum* research is to understand the human and ocean drivers of temperature variability across the USVI and how temperatures are changing in a warming ocean.

Temperature plays a key role in the ecology of organisms in the tropical oceans. It affects current patterns, growth rates, and mortality. In particular, because coral reefs are extremely sensitive to seawater temperature increases, which can cause coral bleaching (loss of symbiotic algae inside coral animal tissue) and death, they are known as "the canary in the coal mine" for global warming in the oceans.

Unfortunately, across the globe and in the USVI the "canary" is telling us to get out of the mine or, in this case, clean up our planet-warming emissions. Sea surface temperatures have been increasing along with atmospheric heating due to global warming. The earth just suffered the third major coral bleaching event on record from 2015-2018, and the worst in terms of duration, intensity, and amount of areas affected.

Since 2005, a year of major mass bleaching and mortality from heat stress, the USVI has seen sea surface temperatures between August and November that routinely exceed thermal stress limits for corals. What is not known is how these increases are changing the dynamics of temperature, the variance between highs and lows, and how this is changing the environment at deeper depths were coral reefs, fish, and other sensitive organisms live.

To meet the challenge of these unknowns, VI EPSCoR has funded cutting-edge thermal stress infrastructure and research from the sea surface to depths where sunlight nearly fades to black. On St. Croix, investments in deep diving training and technology (see the Fall 2018 Newsletter 'Coral Reef Research') have allowed the deployment of temperature monitoring equipment down to 330 feet at three sites.

Across the two-mile deep Anegada Passage at the south St. Thomas shelf edge, VI-EPSCoR researchers at the Center for Marine and Environmental Studies, Caribbean Wind LLC, and Lighthouse Marine have deployed a subsurface buoy capable of monitoring temperature and ocean salinity down to a depth of 330 feet. The instruments on the buoy line communicate with electrical pulses through the steel cable to a data receiving station at 70-foot depth, thus allowing researchers to retrieve data at comparably shallow depths. In the future the data will be communicated to a surface buoy that will send real-time updates directly to researchers at CMES and globally, as part of a web portal. This will allow accurate and fast monitoring of depth-specific ocean temperatures and alert researchers to heat stress events and other phenomena that cannot be detected on the ocean surface.

Previous efforts supported by VI EPSCoR have made the USVI one of the most comprehensively monitored coral reef ecosystems globally, with over 44 research sites in the territory. This has contributed to more than 16 scientific peer-reviewed papers on corals and thermal environments in the USVI and numerous training opportunities for students and employees.

All data are freely available from Dr. Tyler B. Smith (tsmith@uvi.edu).

Dr. Tyler Smith Invited To Serve On A National Academies Of Science, Engineering, And Medicine Consensus Study.

Tyler Smith, Ph.D. was appointed to the National Academies of Science, Engineering, and Medicine (NASEM), supported by the Ocean Studies Board, to participate in the study "Interventions to Increase the Resilience of Coral Reefs".

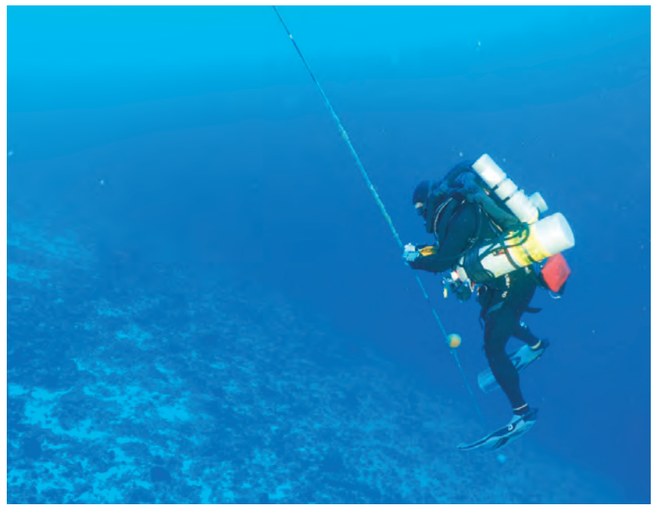
Dr. Tyler Smith, Associate Research Professor of Marine Science at the University of the Virgin Islands (UVI) and a key partner on VI-EPSCoR's Coral Reef Research team, was one of only twelve scientists invited to provide his expert opinion on the different ways humans can intervene to save coral reefs.

Smith is the first faculty from UVI to serve on a NASEM consensus study and considers it quite an honor.

The two NASEM reports lay the foundation for active intervention to support the persistence of coral reefs.

The funding of the study indicates how seriously the United States is taking the problem of understanding how coral reefs might be saved from ocean warming. Therefore, it is likely that coral reef interventions will soon be available for use in the USVI to support the survival of coral reefs in the face of thermal stress, disease, pollution, and ecological change. This will boost existing coral restoration strategies to, among other things, provide coral stocks that are more resistant to thermal stress.

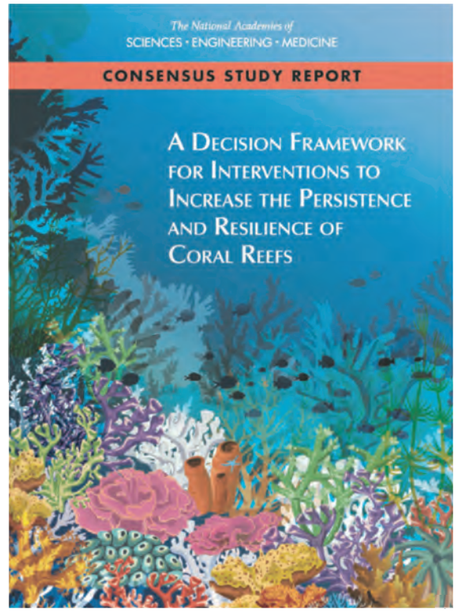
This study was conducted at the request of the National Oceanic and Atmospheric Administration, with support from the Paul G. Allen Family Foundation.



Above, VI EPSCoR research team leader Dr. Tyler Smith during a lab in the Magens Bay Arboretum. Photo: KW Grimes

Below left, Dr. Smith inspects a deeper section of the thermistor string at 270 feet. Oct. 26, 2018; Photo: V. Brandtneris

Below, learn more about the NASEM report at https://viepscor.org/news/2019/6/13/scientists-offer-a-glimmer-of-hope-with-strategies-for-saving-coral-reefs



By Karli Hollister – MMES Candidate in the Smith Lab

Karli Hollister is seen here using 3D photogrammetry to build 3D models of the corals in her study. Photo: T. Smith.

The Effects of Encrusting Algae on Caribbean Coral Reefs

Encrusting algae is widespread and can be found in oceans across the world. It's a rocklike, sometimes reddish crust that is often seen on the sea bottom, rocks and on corals. Although not all species of encrusting algae are harmful to coral reefs, the one found here in St. Thomas, the *Ramicrusta sp.,* is.

My thesis in the MMES Program explores encrusting algae through the use of 3D photogrammetry. This method uses a series of photographs to build high definition 3D models of corals so I can closely examine algal growth on a specimen over time.

Working in the Smith Lab has provided me with the resources needed to complete the project – both on land and in the water. There are five species of corals I have photographed over the course of six months to learn how the encrusting alga is impacting our local reefs.

The species of corals included in my thesis are *Orbicella faveolata,* the mountainous star coral, *Orbicella annularis*, the boulder star coral, *Pseudodiploria strigosa,* the symmetrical brain coral, *Siderastrea siderea,* the massive starlet coral and *Porties astreoides*, the mustard hill coral. So far, we have found that the massive starlet coral is a strong competitor against *Ramicrusta*, while all of the other coral species exhibit little to no resistance to overgrowth by the alga. Since the latter includes some of our important reef building species, it is possible that *Ramicrusta* could not only significantly impact coral species diversity on our reefs, but could also impair the structural complexity of the reef over time.

By Viktor Brandtneris, Technical Dive Office Assistant

UVI's Technical Diving Program Hits Some Big Milestones

"University of the Virgin Islands research accounts for 9.2% of the total published mesophotic body of work...in the whole world." *V. Brandtneris*

Since 2015, the diving safety team at University of the Virgin Islands (UVI) Center for Marine and Environmental Studies (CMES) has been working diligently to increase the dive program's capacity. Advancements in this area have allowed us to continue leading the exploration and study of deep corals reefs.

In the last four years the number of functional rebreathers available to team divers nearly doubled, two new Closed Circuit Rebreather (CCR) divers (Rosmin Ennis and Sarah Heidmann) were trained, and Brandtneris achieved certification as a CCR instructor. The direct result of these efforts is a near quadrupling of annual CCR dives at UVI from 81 in 2016 to 313 in 2018.

Maximum research depth has increased from 210 feet to 330 feet. This is not an insignificant accomplishment for a small university!

In 2018, UVI was ranked second by the American Academy of Underwater Sciences (aaus.org) for the most rebreather dives, led only by the entire United States National Park Service (NPS) which logged 381 dives. Amazingly, UVI CMES had fewer than half the active CCR divers that NPS had during 2018 (UVI - 6; NPS - 13). This puts UVI's technical research diving program on a world class level, rivaled only by a handful of large governmental organizations and private research outfits.

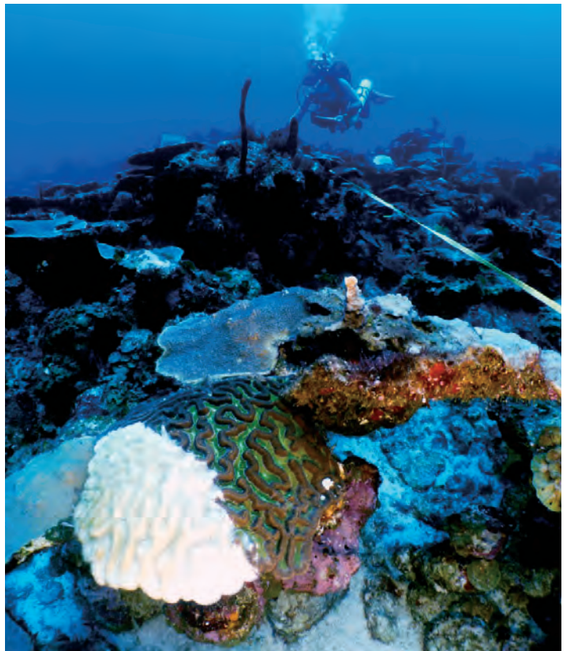
Our position on a Caribbean island immediately adjacent to a broad array of marine ecosystems gives us a unique advantage when it comes to pushing forward the study of deep coral reefs. We might be small, but our core group of highly skilled divers, combined with quality infrastructure (thanks to the investments of VI-EPSCoR), has yielded a truly unparalleled deep reef research program.

The US Virgin Islands ranks third behind Australia and the United States for the output of peer-reviewed scientific studies on mesophotic coral reefs (Turner et al. 2017).

Overseeing the rapid growth of our technical diving program—a set of high risk, high consequence activities—has not been without challenges, yet the future of technical diving at UVI is very exciting. We are well positioned to continue leading the way in the study of deep coral reefs. Now that open circuit technical dive training is in-house, we have the ability to better streamline our training procedures and give graduate students (and someday, select undergrads) unique opportunities to gain significant dive experience in a short period of time.

Our goals are to continue the carefully measured expansion of the technical diving program, increase our technical training rates, and to see our dive team spend a greater amount of time beyond 150 feet, exploring unique, barely studied Agariciid fringe reefs.

Below: Dan Mele, MMES candidate records sightings of the deadly stony coral tissue loss disease found at approximately 120 feet on mesophotic coral reefs. Photo: V. Brandtneris.
Facing page: newly certified technical divers include a visiting researcher, Adam Glahn, CMES Marine Life Restoration Technician, dive instructor Viktor Brandtneris, and MMES candidates Dan Mele and Sonora Meiling. Photo: S. Heidmann.



IN 2018 UVI'S TECHNICAL DIVING PROGRAM WAS:

 # 2 In Dives Below 100 Feet

#1 In Technical Decompression Dives

#4 In Dives Below 150 Feet

#2 In Closed Circuit Rebreather Dives

Emerging Areas

By Kristin Wilson Grimes, Ph.D., Research Assistant Professor of Watershed Ecology

The Grimes Lab Continues to Influence Marine Debris in The Territory.

"...this annual event will continue for the next two years and expand to St. John and St. Croix with a focus on removing remaining hurricane-deposited debris in and along mangrove shorelines." *Dr. KW Grimes*

With community partners, Dr. Kristin Wilson Grimes organized the 2nd Annual Great Mangrove Clean Up in the St. Thomas East End Reserves in April 2019. About 150 volunteers aged 9-70, from seven schools and 13 organizations, participated in the cleanup, removing more the 1,700 pounds of debris from vulnerable mangrove shorelines.

With new funding from NOAA's Marine Debris Removal Program, this annual event will continue for the next two years and expand to St. John and St. Croix with a focus on removing remaining hurricane-deposited debris in and along mangrove shorelines. In addition, this new grant will support the creation of a Marine Debris Action Plan for the U.S. Virgin Islands, a first for all U.S. insular areas. The plan is critical to the coordination and prioritization of future marine debris removal, research, and debris prevention activities in the Territory, including policy decisions and future management actions. Grimes is the Principal Investigator for this new grant and Howard Forbes Jr. from the Virgin Islands Marine Advisory Service is the Co-PI.

This page: volunteers at The 2019 Great Mangrove Cleanup worked tirelessly to remove marine debris from the mangrove lagoon. Photos by KW Grimes.

Facing page: Infographic by Elisa Bryan

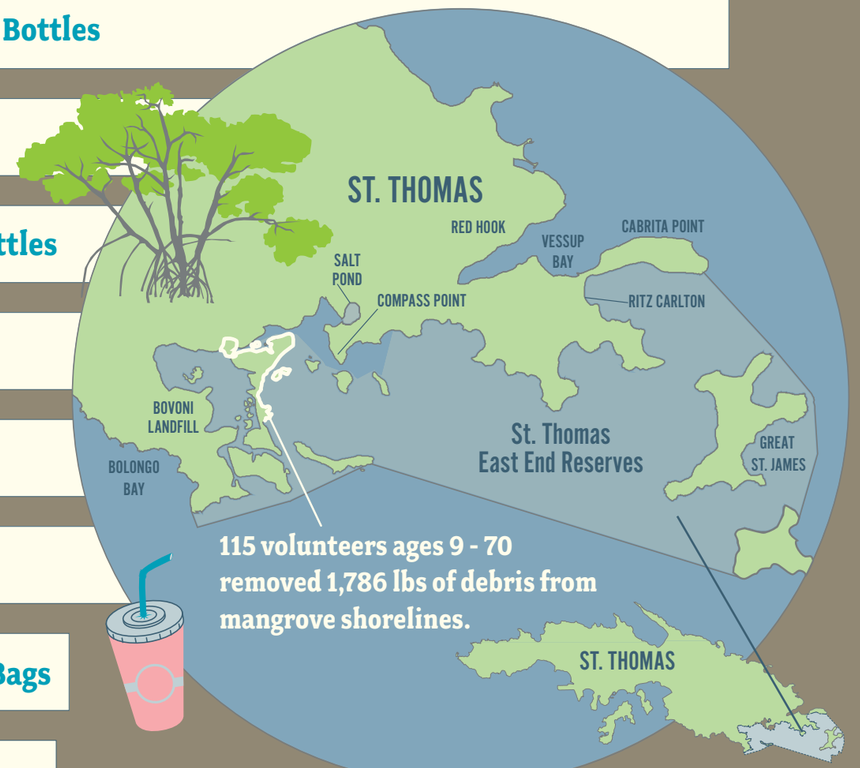
THE 2019 GREAT MANGROVE CLEAN-UP

Of The St. Thomas East End Reserves (STEER)

STEER contains the largest remaining mangrove forest on St. Thomas!

- 246 Plastic Beverage Bottles
- 133 Plastic Pieces
- 114 Other Plastic Bottles
- 113 Plastic Cups & Plates
- 111 Glass Beverage Bottles
- 109 Construction Material Items
- 92 Plastic Grocery Bags
- 89 Other Plastic Bags
- 83 Other Plastic & Foam Packaging
- 82 Beverage Cans

Tracey Saxby, IAN Image Library (ian.umces.edu/imagelibrary/)



115 volunteers ages 9 - 70 removed 1,786 lbs of debris from mangrove shorelines.

"...the data tell us we should all be thinking more about what we eat and drink out of, where we dispose of it, and where it may end up."

Dr. Kristin Grimes, Assistant Professor, Center for Marine & Environmental Studies, University of the Virgin Islands

WEIRD FINDS

- 15 life jackets
- 2 refrigerators
- 1 polaroid camera
- 1 television
- 11 tires

By Kristin Wilson Grimes, Ph.D., Research Assistant Professor of Watershed Ecology

"SEAS Your Tomorrow" Increases Student Interest In Marine Sciences

Dr. Wilson Grimes (PI) and Dr. Marilyn Brandt (Co-PI) continue work on the NSF INCLUDES grant, "SEAS Your Tomorrow" (Award #1649300) which aims to increase student interest and engagement in the marine sciences in the US Virgin Islands.

With continued funding from the Community Foundation of the Virgin Islands, the US Environmental Protection Agency, and the National Science Foundation, this program, now in its third year, has supported 11 underrepresented minority (URM) students in the Bridge to the Ph.D. Program with Penn State University.

Of those who participated in the program, two are now enrolled in Ph.D. programs in the marine sciences as a result of their participation in the program, while a third received a John A. Knauss Marine Policy Fellowship Program through NOAA Sea Grant. Additionally, 12 UVI undergraduates have participated in early career research and professional internship experiences through the program with partners from the USVI Department of Planning and Natural Resources, NOAA National Coral Reef Conservation Program, The Nature Conservancy, the Ocean and Coastal Observing Virgin Islands, Inc., and the Virgin Islands Marine Advisory Service.

Meanwhile, 128 middle and high school students have participated in the Youth Ocean Explorers Program, a four-week, hands-on, summer marine science experience. All of the students benefitted from increased mentorship, individualized career development plans, and family support programming to assist them in their marine science journeys.

Above left: YOE Student Muriel Boumedine, now in high school, above left gave a poster at the 2019 ASLO Conference: Boumedine, M. "Comparing fish preference for natural vs. artificial coral reef." Educator Fair and Poster Session for Local High School Students. Wednesday, February 27, 9-10:45am, Exhibit Hall A. Photo: J. Stout

Above right: Recent MMES graduates and students Carolyn Courtien, D. Elizabeth Smith and Akacia Halliday in in the Water Quality Analysis Lab in the MacLean Marine Science Center Building. Photo: KW Grimes

Below right: Owen Clower, M.S., Photo provided by O. Clower

Two Bridge To Ph.D. Participants begin their own Ph.D. Programs

Akacia Halliday

Virgin Islander Akacia Halliday, embodies the goals of the Bridge Program. She attended Charlotte Amalie High School and then achieved her undergraduate degree at the University of the Virgin Islands. Then she joined the UVI Masters of Marine and Environmental Studies program and participated in the Bridge to PH.D. Program. She successfully defended her thesis entitled, "Environmental correlates of infection rates of an apicomplexan blood parasite infecting Caribbean Stegastes damselfishes" and graduated in May 2019. She is now in the Ph.D. program in Biological Sciences at the University of Mississippi.

"I wholeheartedly thank the Bridge to PhD program for opening my eyes to the great research that is possible in this field, building my confidence as a scientist, and connecting me to this wonderful PhD program. I hope in the future to inspire others the way they all have inspired me." – *Akacia Halliday*

Owen Clower

Owen successfully defended his thesis and graduated from the MMES Program in May 2019. Owen's thesis, entitled, "An investigation into the temporal and spatial trends of contaminants in Mangrove Lagoon, St. Thomas East End Reserves (STEER), U.S. Virgin Islands" found widespread heavy metal and other pollutant contamination of mangrove and lagoon sediments in Mangrove Lagoon which is part of the St. Thomas East End Reserves, a marine protected area on St. Thomas.

A 2018 Bridge to the Ph.D. Program student, Owen is now a first-year Ph.D. student at Louisiana State University in the Department of Oceanography and Coastal Sciences.

Photo: P. Jobsis

UVI Coastal Oceanography Research Takes a Big Step Forward with the Derecktor 55

By Paul Jobsis, Ph.D., Director of the Center for Marine & Environmental Studies &
Sennai Habtes, Ph.D., Research Assistant Professor of Biological Oceanography

In August 2019, UVI's Center for Marine and Environmental Studies (CMES) received a new Coastal Oceanographic vessel. This former Coast Guard buoy tender is a 55-foot *Derecktor* with a design and equipment that will greatly increase the center's ability to conduct coastal oceanography.

This versatile ship has a crane which can lift up to 3500 pounds, allowing UVI to install and remove oceanographic buoys in partnership with the University of Puerto Rico's CariCOOS program and others. In addition, the ship can pull large nets for sampling, and deploy oceanography instruments such as CTDs and Gliders.

CMES research has historically been focused on coral reefs, marine ecology and mangroves, but the addition of a coastal oceanographic vessel allows researchers to start conducting more oceanography related research. This serious investment by the National Science Foundations' VI-EPSCoR program is a perfect example of how this program can expand the Virgin Islands' capacity to conduct research.

UVI hopes to expand its research programs to include all types of oceanography, but will begin by focusing on biological and physical oceanography. Dr. Sennai Habtes' research program on the diversity in plankton as it varies throughout the year will primarily focus on commercially important fish larvae found in the plankton. Optimally, his research will increase understanding of the spawning cycles, stock size, and critical oceanographic conditions during spawning.

Workforce Development

By Lawanda Cummings, Ph.D., STEM Education Director

Creating a Community of Believers in STEM

Continued evidence of excellence in teaching and practice is demonstrated with half of the 2019 nominations for Teacher of the Year emerging from VI-ISERP.

Workforce Development has been granted an amazing opportunity over the last five years to research and innovate around the known pathways for STEM (Science Technology Engineering and Mathematics) talent development. Our efforts have spanned educational enrichment for children in K-12, teacher professional development, college student STEM enrichment and early career STEM professional mentorship. These varied approaches address the need for early exposure/interest in STEM, establishment of rigorous pre-college preparation, and promotion of student academic persistence in STEM programs and as professionals.

The President's Council on Advisors on Science and Technology (PCAST, 2012) reported that a million more STEM baccalaureates would be needed by 2022 to meet the emerging industry needs. The vulnerability of the United States Virgin Islands (USVI) economy is linked to the need for a large, diverse, highly qualified scientific workforce to take advantage of emerging markets and technologies here and throughout the world. Nationally, the competitiveness of American industry is tied to the quality of American universities and educational systems (Porter & Rivkin 2012) and their capacity to develop students ready to engage and innovate STEM markets. The proportion of USVI residents who have earned bachelor's degrees (13.1%) is far lower than the US national average (19.8%; CEDS 2015), and excludes many from increased income potential. Critical efforts in the USVI to enhance STEM workforce development must investigate barriers that facilitate fewer URM students in STEM degree programs and K-12 preparation (Cummings, Lindsay & Burn, 2017).

The primary goal of the Virgin Islands Institute for STEM Education Research and Practice (VI-ISERP) at the University of the Virgin Islands (UVI) is to improve STEM education in the US Virgin Islands to develop a better prepared STEM workforce. VI-ISERP has created a strong foundation for improved STEM education in the Territory through teacher professional development, early career STEM faculty mentorship, and URM (underrepresented minority) undergraduate development. The Institute has worked with in-service teachers from every middle and high school in the Territory. Through Professional Learning Communities (PLCs), we have created a self-sustaining culture in which teachers support the use of research-based best practices, continual professional improvement and reflective practice in the classroom. Continued evidence of excellence in teaching and practice is demonstrated with half of the 2019 nominations for Teacher of the Year emerging from ISERP through the esteemed Ms. Michealrose Ravalier (Winner) and Mr. Mark Joseph Sy (Nominee).

VI-ISERP has developed a stable STEM education research program with three STEM faculty that spearhead critical research with collaborations within UVI and at other institutions. A number of STEM Education research projects have emerged from this rich network of faculty, STEM specialists, teachers, and community partners, impacting K-12 STEM instruction, teacher preparation and the field. Under the guidance of Dr. Nadia Monrose, Dr. Chris Plyley, and Dr. Michele Guannel, more than 40 teachers have presented educational research at national conferences, lending a critical perspective on pedagogy and student development.

At the undergraduate level, efforts to reach all students with an enriched, place-based curriculum continues to connect students' lives to critical scientific concepts. A proportion of incoming freshmen have engaged in service-learning projects, related to resilience, within SCI 100 classes. Dr. Michele Guannel has guided this work to produce a greater number of highly trained UVI students who are exposed early to research and community opportunities and are equipped to educate others as community ambassadors. Much of this work is aligned with projects of the core natural sciences research within VI-EPSCoR and expands the reach of its findings to the community. The service-learning initiative trains and engages full- and part-time faculty to implement these high-impact practices, in close partnership with organizations involved in the recovery of marine and human communities.

Workforce development has also contributed to mentorship of both UVI faculty and students. Dr. Aletha Bauman spearheaded efforts to provide mentoring training for faculty members at UVI utilizing a train-the-trainer model. Models of mentorship have emerged due to faculty integration in critical physics courses to promote student engagement, retention, and STEM career identity development. These aspects of student and early career support remain a key focus for research and innovation around STEM persistence.

We are building a community of believers for a culture of STEM educational excellence. Workforce Development continues to be an active intellectual hub that fosters strategic alliances for research, networking, and innovation in STEM education in the Virgin Islands and the Caribbean. Our core product is a STEM community dedicated to developing and implementing research-based best practices in teacher preparation and training, student learning, and workforce development in STEM fields with collaboration among university faculty, K-12 educators, government agencies and industry. In this last year of funding, we are committed to telling the story of this critical work and the resident genius of our students. This place-based responsive work reflects the strengths, needs, and cultural values of the individual islands, resulting in sustainable efforts for both St. Thomas and St. Croix.

Above: Ms. Michealrose Ravalier accepts her award for Teacher of the Year. Ms. Ravalier is a pioneer in STEM classroom innovation and an VI-ISERP Teacher Mentor. Photo: N. Monrose Mills

Below: Participants in the Youth Ocean Explorers summer program are doing science in their lived world. They gain a desire for understanding marine science practice in the research process. Photo: J. Stout.

By Michele Guannel, Ph.D., Assistant Professor of Biology

VI-ISERP Teachers and Students Shine at the 2019 Aquatic Sciences Meeting in San Juan, Puerto Rico

This spring (2019), VI-ISERP teachers highlighted their project-based learning units and collaborations at one of the largest international oceanographic meetings of the Association for the Sciences of Limnology and Oceanography (ASLO).

The ASLO meeting took place in San Juan, Puerto Rico, further affording Virgin Island educators many opportunities to share curricula with our Puerto Rican peers, as well as internationally-renowned scientists, educators, and policymakers. For most, if not all, participating teachers, this was their first presentation at a major scientific conference. Although many VI-ISERP teachers have presented their work at local conferences (UVI Research Day) and education conferences (ISEA), this forum was unique in that it included nearly 1600 participants, largely aquatic scientists.

Teacher-led presentations were a mix of culturally-relevant lesson plans, many of which are related to aquatic sciences and other issues influencing the Virgin Islands. St. Croix teachers presented projects on heavy metals in fresh and brackish waters, representing a collaboration of seven educators with a Professional Learning Community (PLC) that spans several local schools. Risa Gordon delivered a presentation on lionfish in a session on aquatic sciences management – underscoring the importance of the link between students' families (many of whom are fishers), education on invasive species, and how to more strongly link communities with education. Two talks showcased an ongoing collaboration between math classrooms at Charlotte Amalie High School (Ms. Tameca White, Ms. Otensia Peets-Allamby) and All Saints Cathedral School (Ms. Cleopatra Skerrit), on the topics of renewable energy and marine debris.

In addition to the renewable energy project presentation led by Ms. Skerrit (All Saints Cathedral School), several educators and students told their stories of resilience among schools, teachers, and students. This session was a collaboration among VI-EPSCoR's workforce development arm (VI-ISERP, Dr. Michele Guannel), and VI-EPSCoR's Outreach, Education, and Diversity's Community Engagement Specialist, Mr. Jarvon Stout and Mr. Howard Forbes, Jr. Coordinator of Virgin Islands Marine Advisory Service. This session kicked off with informal educator Kristina Edwards (Virgin Islands Department of Planning and Natural Resources) talking about mobile lessons she conducted in local schools immediately following the hurricanes.In partnership with Dr. Paul Jobsis, University of the Virgin Islands Center for Marine and Environmental Studies (UVI CMES) Director, these community sessions focused on the hurricane impacts on the Virgin Islands Environmental Resource Station (VIERS) and possibilities for its future.

Locally, we know that educators were on the forefront of assisting students in recovery from the hurricanes. Students were supported through hurricane-relevant projects (Skerrit et al: renewable energy projects across CAHS and All Saints), and also through testimonials of educators about the recovery process. Mr. Michael Charles (Sts. Peter and Paul) discussed his school's collaborative approach to restoring the campus for their students. Mr. Vernon Callwood and Ms. Yasmine Salem Jubran designed and administered a Department of Education-approved survey to their fellow educators at CAHS, regarding teachers' perceptions of the impacts of hurricanes on their students. Finally, Dr. Michele Guannel and two former SCI 100 students spoke of a new assignment within this UVI general education course, in which students contribute to ongoing hurricane recovery and research. Notably, UVI sophomores George Francis (Communications) and Lovynette Brown (Education) described their perceptions of the hurricanes and how they contributed to recovery, through working with Perfect Heart and St. Thomas Recovery Team. Of these VI-ISERP teacher presentations given at ASLO, two were presented within a session entitled "Methods in Aquatic Science Education," that is intended to evolve

The STEM Education contingent to ASLO included six St. Thomas teachers from three schools (Charlotte Amalie High School, All Saints Cathedral School, and Sts. Peter and Paul Catholic School), five St. Croix teachers from two schools (St. Croix Educational Complex and St. Croix Central High School), informal educators (Youth Ocean Explorers) and UVI VI-ISERP faculty. File photo.

into a special, education-focused issue of the leading oceanographic journal, Limnology & Oceanography: Methods. Mr. Vernon Callwood of Charlotte Amalie High School was selected for the competitive "Journalist for a Day Program," whereby scientists and educators attended multiple ASLO sessions in order to write one or more storytelling pieces, in an upcoming issue of the Limnology and Oceanography Bulletin. Additionally Salem and Callwood produced a draft manuscript of their study, "Classroom Teachers' Perception of the Impact of Hurricanes Irma and Maria on Student Behavior in High School Classrooms in St. Thomas, United States Virgin Islands," currently is in preparation for publication.

On a broader scale, these presentations at ASLO highlight a growing trend of VI-ISERP support. Teachers who consistently participate in trainings have seen improvements in project implementation and professionalism, including conference presentations and publications. Overall, 29 teachers have successfully completed the Action Research course led by Dr. Nadia Monrose Mills on the St. Thomas campus, and by Dr. Chris Plyley on the St. Croix campus. To date, 23 teachers have presented at peer-reviewed conferences, and 18 more teachers have submitted and accepted proposals. Within the two-week summer workshops, that have contributed over 4000 hours of professional development to local educators, mentor teachers lead colleagues in group sessions, and all participants present their draft lesson plans (and mini-projects) frequently throughout the workshop.

By Nadia Monrose Mills, Ph.D., Assistant Professor of Mathematics

Teacher Participation in STEM Opportunities Grow

The number of St. Thomas and St. John teachers involved in professional development opportunities created by VI-IS-ERP continued to grow throughout the VI-EPSCoR *Mare Nostrum* grant cycle.

We have seen increased participation in the annual intensive two-week summer workshops, the academic year Action Research Course, and, participation in additional strategic yearly training opportunities.

Approximately 25 teachers and administrators participated in the 2019 summer workshop at the University of the Virgin Islands' St. Thomas campus. Their involvement in the workshop is just the beginning of the work that they are required to complete during the school year. For example, teachers who participate in the Action Research Course, taught by Dr. Nadia Monrose Mills on the St. Thomas campus, have implemented projects, conducted research on them, and have gained the presentation skills needed to participate in local and national meetings. Teachers who consistently participate in trainings have seen improvements in their in-class projects and in their own professionalism which has been demonstrated through participation in and presenting at conferences.

Since January 2018, 20 teachers have had peer-reviewed research presentations at major local, national, and international professional meetings; to date, three teachers are co-authors on the published proceedings of one of these meetings. These projects and presentation skills are developed continually over the year, with active participation growing in both districts.

We are constantly looking for innovative ways to provide our teachers with professional development opportunities. When the Action Research Course was cancelled in the Spring of 2019 due to low enrollment, we retooled our approach to remaining engaged with our teachers by partnering with Timothy Kentopp, a computer scientist instructor at UVI to offer four, 3-hour, training sessions on coding and instructional technology. Fourteen teachers successfully completed this training.

Education, Outreach & Diversity & The MMES Program

University Bound participants kayak in the Mangrove Lagoon.

By Liza Margolis, Education & Outreach Coordinator

Education, Outreach and Diversity

Since its inception, the Education, Outreach and Diversity (EOD) component of *Mare Nostrum* has operated with the goal of bridging the gap between the U.S. Virgin Islands' scientific and underserved communities.

EOD's outreach methodology focuses on:

– Increasing environmental awareness and literacy;

– Increasing STEM literacy and affinity;

– Promoting environmental stewardship; and

– Helping build and foster a more diverse and locally driven STEM workforce within the Territory.

For the duration of the *Mare Nostrum* grant we created and strengthened invaluable partnerships and innovative culturally relevant outreach techniques. Our initiatives bolstered outreach in both formal and informal settings to directly connect with underserved segments of the community.

In 2017, after hurricanes Irma and Maria hit the US Virgin Islands, the community was necessarily consumed with hurricane recovery efforts. As a result, opportunities to engage audiences shifted to focus on more timely topics such as marine debris and resiliency. As an example, in the past two years, 11 elementary and middle school workshops focused on marine debris.

Through relationship building meant to strengthen community partnerships and working with EPSCoR scientists on focused workshop topics, the EOD team remained committed to disseminating new and updated research content in a format that made it accessible and relevant to the Virgin Islands community.

Turtle tagging events have become one of our most popular and heavily attended community engagement activities. All turtles are handled by marine biologists pursuant to NMFS permit #15809. Photo: Dan Mele.

By Jarvon Stout, Community Engagement Specialist

Community Engagement Highlights

Effective outreach requires the ability to share information in ways that are developed for, and palatable to, a specific audience. Throughout the course of the *Mare Nostrum* grant, the EOD team has developed and adapted several community outreach initiatives with this in mind. Many of these have become novel ways of broadening and extending VI-EPSCoR's presence and reach throughout the community.

MMES students Alexandra Gutting and Kathryn Cobleigh demonstrate how coral nurseries work at the 2019 Reef Rest event and encourage participants to volunteer for VI Reef Response Citizen Science SCUBA dives. Photo: E. Bryan

Virtual Reality goggles captivated young participants at a recent community-focused coral disease identification workshop. These future marine specialits experienced what it was like to SCUBA dive through a coral nursery. Photo: E. Bryan

Reef Fest

In partnership with the Virgin Islands Marine Advisory Service (VIMAS), Reef Fest has quickly become one of our most impactful community outreach initiatives. Each year we see increased participation from local schools, restaurants, non-government organizations and community groups. There has also been a major increase in attendance. In the past two years, Reef Fest events have each averaged 700 to 800 attendees of all ages and backgrounds and sectors within the community. Our long-term goal is to continue to build upon the event's existing framework to more effectively engage the public and increase environmental literacy, awareness and stewardship in the Territory.

Virtual Reality

The EOD team works constantly to improve and maximize its efforts regarding effective community engagement. It has begun to utilize innovative, technology-based tools. Virtual reality in particular is now an important element in much of EOD's school and community–based outreach. In partnership with UVI researchers and entities such as VIMAS, the EOD team has started creating and publishing virtual reality tours that highlight important *Mare Nostrum* research. Topics have included coral reef research, coral nursery management, mangrove restoration, and sea turtle conservation. These tools make it possible to bring marine science to a community that tends to not be conscientious of its natural resources.

University Bound

VI-EPSCoR's partnership with the University Bound (UB) program continues to expand. UB is a UVI college preparatory program for underserved youth. Initially, STEM enrichment activities numbered three per year and were conducted during the program's summer session. As of the spring of 2019, the number of UB activities has increased to 11 per year, which spans the program's summer, spring and fall academic sessions.

The diversity of STEM disciplines and STEM practitioners that the students are exposed to through our partnership has also grown. To date, several UB cohorts have had the opportunity to dive into topics such as oceanography, engineering, green technology, virtual reality, astronomy, physics and conservation ecology.

Student surveys show that these enrichment efforts have begun to have positive impacts on students' feelings towards, and understandings of STEM.

Youth Ocean Explorers

The VIMAS Youth Ocean Explorers (YOE) program, now in its fourth year, has seen exponential growth. Introduced on St. Thomas, this year it expanded to include participants on St. Croix. It has also spread to a range of age groups. Thanks in part to funding and personnel support from VI-EPSCoR and outside partners, the program has branched off to include the Junior Ocean Explorers program which runs for one week and caters to students in grades 4-6. These expansions make it possible to engage and impact more underrepresented students at various points in the K-12 academic pipeline.

Since the program's inception, twenty-three YOE students have gone on to earn their Open Water SCUBA certifications and are now assets for important Mare Nostrum initiatives such as Virgin Islands Reef Response.

The Mangrove Restoration Project

The Mangrove Restoration Project is an EPSCoR supported Virgin Islands Marine Advisory Service (VIMAS) initiative aimed at restoring red mangrove coverage throughout coastal wetlands of the USVI. The program uses community volunteers to bolster efforts to collect, grow, and outplant red mangrove seedlings.

Jason Quetel from Caribbean Oceanic Restoration and Education Foundation (C.O.R.E.) demonstrates to Youth Ocean Explorers participants how to safely handle and clean a venmonous lionfish. Photo: J. Stout

UB students enjoyed a behind the scenes tour of Coral World Ocean Park which included discussion on marine careers and real-life experiences in higher education. Photo: J. Stout

By Kristin Wilson Grimes, Ph.D., Research Assistant Professor of Watershed Ecology

Meet The 2019 MMES Cohort

In their first lab to the Magens Bay Preserve with Dr. Kristin Wilson Grimes, the 2019 MMES cohort hiked the nature trail, gaining familiarity with terrestrial environments of the USVI, including wetlands and tropical dry forests, and the common species present in each.

They also gained an appreciation for how past and present management and natural disturbance events, like the 2017 hurricanes, have shaped and continue to affect the landscapes and ecological communities of the Preserve. *Photo: KW Grimes*

Also at Magens Bay, students surveyed ghost crab burrows as part of the The Marine Biodiversity Observation Network Pole to Pole project which is collecting those data and associated environmental data for beaches from Atlantic Canada to the tip of South America. It is the first time such data have been collected for the territory. (http://www.marinebon.org/pole-to-pole.html)

Photo: KW Grimes

Choose Adventure!

The MMES Program accepts applications for Fall 2020 enrollment through March 1, 2020. If you are interested in joining the team and work with world-class biologists on internationally significant topics go to https://www.uvi.edu/research/center-for-marine-environmental-studies/research/

By Sophia McKenzie, MMES Coordinator

VI-EPSCoR Partners Closely With The MMES Program

The Master of Marine and Environmental Science Program (MMES) is supported by *Mare Nostrum* through research assistantships (RA) and scholarships in STEM (S-STEM). *Mare Nostrum* have provided stipends, funds for conference travel and thesis research supplies, and in some cases, offered tuition waivers to students. The possibility of an RA or fellowship increases the attractiveness of the MMES program to applicants and often seal the deal in students' decision to attend UVI. The majority of students receiving RA or fellowships, have high success rate and graduate, which reflects well on the program and University. The financial freedom afforded in these cases allows the student to focus on their education without having to seek employment outside of the University. Students afforded funds for research materials are supported in terms of their thesis projects and able to pursue experimental designs they may not otherwise be able to as a financially strapped graduate student. Furthermore, the ability to travel off-island to present their research, attend conferences, and network with other scientists is immensely valuable to our students.

Outreach is extremely important to the MMES program and is one of the ways in which we are supported by *Mare Nostrum*. Our graduate students conduct valuable and interesting studies as a group for their capstone research, through internships and directed independent research classes, and thesis projects. Informing the community about this research is essential to spread knowledge and increase understanding and appreciation for science, as well as attracting future scientists or MMES students. Outreach events made possible with *Mare Nostrum* funding were vehicles for our students to reach members of our community for education purposes as well as marketing of the program. The Adobe Creative suite of software is accessible to MMES students thanks to VI-EPSCoR, which has elevated the presentations and outreach materials distributed by students.

Once per month, the graduate students host First Fridays, an event that includes a seminar, usually by a visiting scientist, followed by a barbeque. Supplies for the barbeque up to $100 are funded through *Mare Nostrum*. This opportunity to reach beyond MMES to invite students and faculty in other departments creates a unique environment where ideas can be shared, and connections are made. Students and faculty look forward to this event as a time to socialize, learn, and strengthen the UVI community.

Thanks to *Mare Nostrum* funding, the MMES program has been able to support higher enrollment than in years previous, and we see higher student success in terms of graduation rate and achievements. Our close partnership with VI-EPSCoR has been fundamental to the MMES program.

Above, MMES students Kyle Jerris and Jessica Levenson at the Association for the Sciences of Limnology and Oceanography (ASLO) Aquatic Sciences Meeting in 2019. Kyle and Jessica both received the S-STEM fellowship. Photo: L. Buckley

Below, MMES student Kaliegh Schlender at Reef Fest demonstrating microplastic impacts on the environment Photo: L. Buckley

The Intersection of Science & Communication

Joseph Townsend, second year Masters of Marine & Environmental Studies candidate and author of this essay makes science learning fun for children at a Department of Planning and Natural Resources Science Saturday event. Photo provided by the author.

I often surprise people with my undergraduate degree: Bachelor of Arts in biology with a minor in marine sciences, coupled with a second degree in communications. It all seems to shout *"Indecision!"*, particularly as I am now in the Masters of Marine and Environmental Studies program at the University of the Virgin Islands. However, it is increasingly apparent that the scientific community is in dire need of skilled communicators.

Scientists often see their work caught in the cycle of researching, publishing in peer reviewed journals, and then recirculation into the scientific community. This cycle results in the loss of an important audience: the general public. This long-standing closed loop is now being re-examined by both passionate advocates within the science community and trained communications specialists, all understanding that without communication, research cannot become action.

In order for science communication to truly flourish, it is essential we foster scientists who are communicators and communicators who are scientists. My personal mission is to help scientists learn how to bring their work beyond the peer-review process, simultaneously helping communicators dig deeply into the sea of research information to find the crucial detail. Empowerment of both sides is essential because the stronger the overlap, the more powerful a message becomes.

I recently had the opportunity to work with VI-EPSCoR as a student assistant, a position which provided me with the opportunity to continue this journey towards creating the bridge between research and science communication. My job description was as broad as both of my degrees - take scientific material and reshape it into interesting, understandable language for consumption by the general public. I explored what specific research papers were really about, distilled what scientists are doing with that information, and then most importantly determine how to bring it forward so that the whole world knows as well.

My real hope is to encourage and inspire others to take a shared interest in both science and communications, and recognize them as fields that, while separate, are uniquely intertwined. If the work I and others are doing can make one person stop to and consider how research affects them every day (and maybe refuse that plastic straw!), it is a success. If one researcher takes the time to explain ocean acidification to wide-eyed elementary schoolers, that is success. From our knowledge, from our research, and from our community, action happens through connection, and so continuing to connect is more than a career, it's a passion, and for me, it's a lifelong dream.

Joseph Townsend

MMES Student Zola Roper Interns with NOAA

Current MMES student Zola Roper guides young Reef Fest attendees in a marine debris game intended to engage and educate on the causes of and solutions to the marine debris epidemic experienced here in the U.S. Virgin Islands. Photo: E. Bryan

MMES graduate student Zola Roper began a 2-month internship with the NOAA Marine Debris Program at NOAA headquarters in Silver Spring, MD in September, 2019. While there, she worked closely with individuals in this program in communications and outreach, aligning with her career goals. This non-academic internship was funded through a supplemental award to our current NSF INCLUDES DDLP (Award #1649300), through the DCL 18-102.

Zola also gave her first scientific talk at a professional meeting. Her talk is entitled, "Trends in US Virgin Islands marine debris from a historical, citizen science-collected, territorial dataset (1988-2016).

Dr. Kristin Wilson Grimes, Research Technician Allie Durdall, and Zola participated in a 1.5 day, USVI Marine Debris Emergency Response Workshop led by NOAA's Marine Debris Program at Coral World August 20-21, 2019. Territorial partners and other non-profits and businesses participated in the workshop providing input on the draft plan to better coordinate responses to marine debris created by future acute events like hurricanes and tsunamis.

MMES Student Dan Mele Interns with OCOVI

MMES candidate Dan Mele and OCOVI project director Roy Watlington prepare a NOAA-AOML glider for launch. Photo: L. Buckley

Dan Mele (above left), is the University of the Virgin Islands Masters of Marine and Environmental Studies student intern for Ocean and Coastal Observing of the Virgin Islands (OCOVI). Roy Watlington (above right), is the OCOVI project director and retired Chancellor of UVI. Dan is creating an informative video of the glider missions. Together they prepare the National Oceanic and Atmospheric Administration Atlantic Oceanographic and Meterological Laboratory's (NOAA-AOML) SG688 glider for launch at the UVI MMES dock on August 19, 2019.

This AOML glider will maneuver to a position south of St. Croix and will follow a trackline through the hurricane season as a part of a larger array of gliders already deployed in the Virgin Islands by OCOVI in cooperation with Caribbean Regional Association for Coastal Ocean Observing (CariCOOS), Rutgers, NOAA-AOML, and the U. S. Navy to provide critical oceanographic data. Follow along to watch the gliders and look at the data at the Integrated Ocean Observing System glider data center https://gliders.ioos.us/map/

The Virgin Islands Established Program to Stimulate Competitive Research (VI-EPSCoR) was awarded $20,000,000 by the National Science Foundation to implement the project *Mare Nostrum Caribbean: Stewardship through Strategic Research and Workforce Development.*

Mare Nostrum Caribbean

This grant presents a unique opportunity to address the implications of climate change for insular social-ecological systems. Small island communities suffer from a suite of similar problems: limited natural resources, narrow economic base, emigration of young professionals seeking better economic opportunities, heavy reliance on outside entities for goods and services, and the ever-increasing threat of global climate change.

In the United States Virgin Islands (USVI), nearshore marine ecosystems, especially coral reefs, are key to its economic viability, but they are also especially vulnerable to both land- and water- based human activities and oceanographic-climatic disturbances. To address this vulnerability, VI-EPSCoR focuses on developing both human and infrastructure capacity to conduct marine research to improve both management and stewardship of these ecosystems.

Areas Of Research

Among our different research areas, the primary goal of our coral reef research program is to integrate physical, biological and human factors to explain the process of ecosystem dynamics, disease, and demographics (the 3Ds). An integral component of this research is our investment in emerging areas of research (oceanography, watershed dynamics, and human dimensions). This allows the USVI to synthesize knowledge about the various factors (including those affected by climate change and human impact) that control degradation, tolerance, and resilience of Caribbean coral reef ecosystems, so that the best management strategies can be identified. Additionally, as we capitalize on the unique human, and natural resources and the location of the USVI, we will create a world class research destination producing innovative exploratory approaches and global leadership in environmental research.

VIRGIN ISLANDS EPSCoR

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