

VI-EPSCoR ANNUAL REPORT 2021

SECTIONS

Award number: 1946412

Title: RII Track-1: Ridge to Reef Processes and Interdependent Drivers of Small Island of Small Island Resilience

Awardee Institution: University of the Virgin Islands

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OVERVIEW

The Ridge to Reef (R2R) project derives its title from our efforts to take a detailed look at the land-based inputs that can originate along the islands' ridges and stream beds that, following rain events, flow down the hillsides and enter the marine environment. These inputs from the land include sediments, debris, organic wastes from animals and septic tanks leaks, and complex hydrocarbons and heavy metals- all which can enter into our mangrove forests, rocky coastlines, and beaches and eventually into the offshore seagrass beds and coral ecosystems. While studying the content and frequency of these run-off events, the R2R teams also seek to understand the other impacts of the changing environmental conditions on our small islands' social and ecological systems.

The ability of our coastal and marine resources to resist and recover from disruptions and activities, are key to their long term resilience. Understanding these disruptions (the drivers of change) is the overarching focus of the R2R project. The R2R teams will advance our understanding of the various factors including those exacerbated by climate change that drive environmental degradation, decrease resistance to disturbance, and reduce the resilience of Caribbean coral reef ecosystems. To help counter the impacts of these disruptions, we are also developing and implementing science-based ecological restoration approaches that emphasize biodiversity. These approaches will complement ongoing ecosystem studies that in turn will inform the best available management strategies to increase resilience of marine and coastal habitats. The Ridge to Reef project will also work to develop the next generation of Virgin Islanders who can ensure a resilient future for the Territory's natural resources - a key element for sustaining our tourism-based economy here in the Caribbean in the years ahead.

THE VISION of R2R is to improve understanding of the drivers, processes, interdependencies, and consequences of ecological change driven by natural and anthropogenic disruptions in Caribbean coastal and marine ecosystems.

THE MISSION of the project is to advance science-informed knowledge that guides managers, researchers and communities to more effectively manage the natural resources of the Territory while we adapt and respond to the impacts of climate change

The R2R Project was initiated during the COVID-19 pandemic. The host institution, the University of the Virgin Islands (UVI), and the entire jurisdiction were subjected to varying levels of business, government, and school closures. Like the rest of the country, we were also impacted by travel restrictions and public health measures that curtailed the behavior and choices of all citizens. UVI transitioned to a virtual learning campus for both the Fall 2020 and Spring 2021 semesters, with researchers and teaching faculty using Zoom and other virtual communication platforms to engage their students, colleagues and collaborators. Research activities as well as most outreach and informal learning activities were suspended, delayed or severely restricted (e.g., scuba diving operations and other boat-related activities).

Nonetheless, the R2R component teams were still remarkably productive and managed to address many of their Year 1 goals and objectives. Faculty, staff and students alike adapted to the virtual learning environment. Researchers postponed some of their field research efforts to begin in the summer 2021 (between Year 1 and 2), or even later, but managed to use virtual meeting platforms to keep engaged with prospective and current students, collaborators and develop outputs from modeling efforts, literature and data reviews. Given that this was the first year of R2R, most researchers had planned to use the first year to plan and address logistical needs. These included buying supplies, recruiting students and postdocs, and procuring permits for the research sites from both Territorial and federal agencies. Fortunately, most of these efforts were accomplishable under the pandemic-related constraints.

Summary of Key Accomplishments achieved during the Reporting Period

Watershed Monitoring and Land Use

The research group led by David Hensley has successfully applied for and have been granted permits from both federal and territorial agencies. These permits are needed for conducting research on both private and public lands including the farms and watersheds under study. Hensley and colleagues have also physically ground-truthed and geo-tagged the planned study areas in both St. Croix (Salt River) and on St. John (Fish Bay), the latter completed with assistance from Fish Ecology team lead Rick Nemeth. Both sites are currently being reference sampled (May 2021).

As part of their efforts to identify and monitor sediment and nutrient fluxes in these VI watersheds, Hensley has developed both protocols and customized the sediment trap design to fit and function reliably in the ephemeral stream beds in the study sites. He also has worked with Coral Resilience team lead Tyler Smith and others to adapt the sediment traps for use in shallow coastal waters. Similar efforts for tracking sediments inland as part of the conservation buffer study have also been completed. Hensley has also successfully completed the search for a watershed and soil science post-doc and the committee is currently reviewing the applicant pool.

Hensley and his team have collected soil samples for all eight of the ground cover and agroforestry/landscape study fields. These samples have been color-classified and physically processed for gravimetric moisture content and chemical lab analysis. On the laboratory side, the UV-Vis spectrophotometer which will be used in sediment source tracking has been delivered and is currently undergoing calibration for reference sediment samples. Hensley and his team have also developed water analysis protocols for nitrate and phosphate detection (for nutrient flux estimates) for both watersheds. A collaboration with another research team (non-EPSCoR, territorial funded) was established in March 2021 to cooperate on Salt River hydrological data collection and sediment sampling during the 2021 rainy season, because this team is also engaged in a watershed analysis of Salt River and several other Virgin Islands watersheds for 2021. Water sampling protocols will be harmonized with this team to the extent possible to allow for a greater collaboration and cooperation.

Mangrove Ecosystem Function, Recovery and Restoration

The research group led by Dr. Kristin Wilson Grimes successfully compiled aerial images of the mangrove distribution past and present from documents- a key step in understanding the distribution of these important species and their habitats. Wilson and her team have submitted applications for both federal and territorial permits for the research they've planned. Meanwhile the team has been productive with proposal development and submission- 3 funded and 3 pending, as well as with publications (2 in press and 2 in review) Key to the future success of the group is the recruitment and hiring of the "workforce" needed to achieve the milestones for this mangrove research component, including students and the mangrove restoration post-doc. A finalist for the postdoc position has been selected and we are awaiting the completion of the paperwork for their hiring. Meanwhile four graduate and two undergraduate students have been recruited to work on the mangrove themes.

Emerging Areas: Seagrass Ecology and Beach Dynamics

The research team focusing on macrofauna movement in seagrass beds is led by Dr. Paul Jobsis and currently assisted by two graduate students. Local and Federal protected species permits have been submitted and are under review. Jobsis and team will collaborate with USGS researcher, Dr. Kristin Hart and work under her current permit if his permit approvals are delayed.

Most of the research equipment has been purchased by leveraging external funding from Lana Vento Charitable Trust, the Baird Family Foundation, and the National Save the Sea Turtle fund. NSF-EPSCoR funds were used to purchase batteries needed for the acoustic array needed for tracking the turtles and other target species. The use of donor funding supports the expansion of the array's deployment to areas known as resting or foraging habitats of the turtles and fish species.

The hiring process for the acoustic telemetry post-doctoral fellow is nearly completed and the finalist is expected to be identified by the end of Year 1. Three masters' students have been identified and recruited to focus on movement ecology and animal tracking in Brewers bay over the next two plus years.

The beach dynamics research led by Dr. Greg Guannel is focusing on quantifying the role of seagrass beds on moderating beach erosion and help beaches rebuild after storms. Due to the pandemic, most field activities have been postponed. Nonetheless

the team conducted an inventory of beaches in the territory and evaluated methods to estimate beach relative stability, thus successfully identifying which beaches to focus on to quantify the short and long-term impacts of seagrass beds.

The team chose not to hire an undergraduate student to help with field activities. However, they successfully recruited a Ph.D. student (starting Fall 2021), through a collaboration with Drs. Brett Webb at the University of South Alabama (USA) and Edwin Cruz-Rivera (UVI). This decision was necessary to help ensure that the graduate student employed for this project would have sufficient training in physical science and engineering needed to complete the research. Under this agreement, the student would graduate from USA, but receive a stipend from UVI.

The wave measurement and analysis has been postponed because of suspension of field activities. However, the team was able to obtain 20 years of wave hindcast data from University of Puerto Rico and analyze it for the USVI. The results allow the team to gage the relative wave exposure of various sites in the USVI – essential for future modeling efforts at the selected sites. The equipment needed for wave measurement—wave pressure sensors and wave buoys have been procured.

The seagrass and *Sargassum* research team led by Dr. Edwin Cruz Rivera successfully recruited and advised three new or continuing graduate students, including an M.S. student through an external collaboration with University of Alabama, Birmingham. Research on seagrass through the R2R project has stimulated additional external collaborations – so consequently, a Memorandum of Understanding with NC Central University is currently under development to support research that will be characterizing secondary metabolites of the invasive seagrass *H. stipulacea* and providing key chemical data in support of UVI graduate student Jendahye Antoine's research.

At present two of four collection permits requested have been granted for the research and equipment has been ordered. Meanwhile, research characterizing the effect of *Sargassum* accumulations on beach detrital fauna –led by sub-awardee, Dr. Chris Rogers (Kansas Biological Survey) –has resulted in a manuscript currently under review. Two proposals expanding on R2R *Sargassum* research have been submitted during this period.

Fish Ecology and Herbivory

The research group led by Dr. Rick Nemeth have begun reviewing long-term historical data of coral reef ecosystem shifts from low to high macroalgal cover that might affect

the composition of parrotfish herbivore communities. This data will help determine how the benthic characteristics of the habitat have changed over time and may inform future rates of change that are expected to influence parrotfish distribution. The team has also successfully completed the preliminary logistics (research permits, IRB approvals, equipment acquisition, graduate student recruitment, and research site plan) essential for launching their field season beginning in late May 2021. In addition, a grant proposal has been submitted to Puerto Rico Sea Grant College program to leverage the VI-EPSCoR funded research.

Oceanography

The Oceanography research is led by Dr. Sennai Habtes and is supported by investigators Dr. Paul Jobsis, Director CMES, and Dr. Doug Wilson, courtesy oceanography professor to UVI. Dr. Habtes has decided to take a leave of absence from UVI to serve as the Bureau Chief of Fisheries for the Division of Fish and Wildlife at the Virgin Islands Department of Planning and Natural Resources. Despite this development, the oceanography team with support from the other marine science researchers (Jobsis, Nemeth, Wilson, and Smith) has focused on planning and preparing to complete the research efforts identified in the R2R Strategic Plan. The team has completed an audit of existing instrumentation and determined the necessary equipment needs moving forward. This has included sending monitoring equipment such as ADCPs for calibration and repair, as well as the purchase of four new ADCP's for deployment at the reef bay and coral restoration sites. To prepare the data from UVI instrumentation for R2R research, the team has been finalizing manuals, standard operating protocols, and the processing and quality control of all the data that has been previously collected and developed the infrastructure on the Microsoft AZURE cloud computing server for storage and archiving of this data.

Habtes and Nemeth (Fish Ecology lead) have conducted site characterization surveys of both sites in Fish Bay. The outputs of the surveys have informed sampling and deployment plans being developed by oceanographic technician Vanessa Wright. These efforts have included analysis of what research objectives in the R2R strategic plan can be continued and which may have to be redesigned. The R2R PI Waddell and the co-PIs Nemeth and Smith will determine what objectives will be continued or redesigned by the start of Year 2 and will report their decisions to NSF EPSCoR program leaders.

Under the previous Track 1 award (*Mare Nostrum*) the oceanography team developed a simple numerical modeling system for the US Caribbean coastal ocean waters. The

team used the model outputs from the parent grid and simulate the ocean properties around St. Thomas and St. Croix at a higher resolution of 330 m, which is currently the finest resolution compared to any other operational system for the US Caribbean region. The team used the outputs from the model to analyze the impact of the local circulation on the dynamics of different larval species and the dispersion of sediments. These results are currently being developed into a manuscript by postdoctoral researcher Dr. Sonaljit Mukherjee and Dr. Habtes. Another manuscript on the comparison of the performance of different mesoscale models in the US Caribbean ocean is currently under review at the Journal of Operational Oceanography.

All recruitment for undergraduate and graduate students have been postponed due to Dr. Habtes' leave of absence. However, it has been recommended that the funding for these students be re-allocated to Drs. Nemeth or Smith, who are collaborating and likely incorporating the research objectives of the oceanography research area under the fish ecology and coral resilience research areas, respectively.

Coral Disease and Restoration

The research group led by Dr. Marilyn Brandt have successfully summarized existing datasets on disease distribution and have submitted two manuscripts for publication with another two in prep that are expected to be submitted by the end of year 1. Additional experiments examining disease incidence across experimental species assemblages will be initiated before the end of year 1 and into the fall of 2021. Meanwhile, work on integrating the hydrodynamic modeling results with disease distribution is ongoing. A grant proposal was submitted to the NSF Ecology and Evolution of Infectious Disease program. A proposal was submitted to the National Park Service to support coral restoration in the Virgin Islands National Park and another proposal was submitted to the DARPA "Reefense" program.

Given the overarching goal of the coral restoration research focus is to identify key factors that increase the success of coral restoration activities, a recent disease transmission experiment was completed and determined that direct outplanting, versus nursery rearing of coral outplants, may cause corals to be more vulnerable to disease. Since then, a multi-species outplanting pilot experiment was implemented and is currently being monitored. In this first year, six graduate student interns participated in coral restoration research and activities, and an education program was established with a local business, the Lovango Resort and Beach Club.

Coral Reef Resilience

The research team led by Dr. Tyler Smith successfully created a comprehensive database of external drivers (of coral ecosystem resilience) focusing on biophysical regimes at 42 long-term research sites, with emphasis on describing stressors, disturbance, and other processes that have a potential influence on reef resilience at each location. These external drivers include key areas of temperature, benthic orbital velocity, and water quality. A quality-controlled benthic temperature database from most of the resilience study sites has been developed and includes all data covering the study period up to 2019.

Also in year 1, remotely sensed water quality products were developed for validation sites and developed into ocean color metrics for the USVI as part of a NASA EPSCoR project. An additional NASA EPSCoR proposal was submitted to refine these metrics to the next generation of space-based sensors, but we will concentrate on in-hand metrics for this project.

Progress has also been made in building a database of internal drivers (of coral ecosystem resilience) in key areas of coral diversity, marine disease, nuisance species, other invertebrates, fish diversity, herbivory, rugosity, coral health, and coral interactions. These databases are currently undergoing quality control evaluation. The 2020 Masters of Marine and Environmental Science student cohort used the development of herbivory metrics (biomass, grazing pressure, grazeable substrate) as part of their second semester capstone project to investigate the role of herbivory in reef resilience. This project laid the foundation for developing the herbivory metrics and resilience metrics to be used in the R2R resilience study and the students are writing a draft manuscript to be submitted for peer-reviewed publication. This has resulted in student engagement in the R2R project and jump-started the process of metric development for the resilience study.

Education and Workforce Development

Education and Workforce Development (EWD) team is led by Dr. Lawanda Cummings. They have focused on promoting STEM learning in both formal and informal spaces in the USVI. The interpersonal and community-oriented nature of their work with local schools, with k-12 STEM teachers, undergraduate students inside and outside the classroom, and their efforts with stakeholders in informal spaces were significantly impacted by the COVID-19 pandemic more than any other component of the R2R

Project. Nonetheless, a number of the goals for EWD were met in year 1. The majority of activities were modified to virtual formats or curricula aligned to the needs of teachers/students across the various impacted educational institutions.

One of the more substantive efforts of the EWD teams that builds off of the work from the previous Track 1 (*Mare Nostrum*) is their facilitation of a series of annual Summer Teacher Workshops. These workshops are open to all K-12 educators in the Territory that includes intensive professional development (PD) on pedagogical best practices, the development of curricula focusing on island ecosystem resilience, STEM content knowledge, STEM career knowledge, and emergent needs.

Cummings and her team scheduled and hosted a meeting with Virgin Islands Department of Education Science and Math coordinators to coordinate summer 2021 workshops. A needs assessment was completed by teachers to determine the particular PD needs in response to COVI-19 changes in instruction. 50 educators across the 2 islands have registered through a Virtual STEM Institute. The workshops will be completed before the end of the Year 1.

Drs. Chris Plyley and Nadia Monroe Mills designed the curriculum for the Project Based Learning (PBL) certificate program. This program is designed to serve as a structure for developing and maintaining enhanced Professional learning communities (PLCs). The team has worked with the R2R communications specialist to develop a website to host descriptions of the program and cohort information. Drs. Plyley and Monroe Mills also created a contract, job description, outlined expectations, advertised positions, and hired two students for Year I Summer. The team also hired a graduate student to provide training and oversight for undergraduate researchers.

In response to the pandemic's disruptions on student instruction, the WFD team completed an assessment to clarify the needs of local teachers from VI-ISERP. Teachers indicated needs for technological support, distance learning strategies, student engagement plans, as well as personal/professional support. Ten virtual "Teacher Talk Fridays" were developed and completed, covering the identified topics. Assessment and evaluation procedures were conducted and the team is currently conducting analysis for an internal report.

Dr. McSween has recruited UVI faculty for mentor training through the Center for the Improvement of Mentored Experiences in Research (CIMER) at the University of

Wisconsin to increase the institutional capacity for effective student support. Due to course shifts due to COVID-19, faculty will complete training in summer 2021. The Undergraduate Education Research team, led by Dr. Michele Guannel, began studying the factors that increase recruitment, retention, and persistence of URM undergraduates in STEM and resilience-related majors, minors, and certificate programs. They analyzed existing data from 2018-2020 from the Science 100 course (required for all incoming UVI freshmen). The team targeted the qualitative analysis of students' lived experiences with the 2017 hurricanes and produced a baseline understanding of Virgin Islanders' definitions of preparedness and resilience, as well as strength and needs within resilience education. In the current Year 1, the team relied on fully virtual projects exploring community perceptions of COVID-19 and COVID-19 vaccines and other topics. New, project-oriented Social Science 100 modules were developed that focused on topics such as "Vaccine Science and Addressing Community Skepticism," "Pandemic Public Health and Preventing Community Spread," and "Mental Health and the COVID-19 Pandemic." Guannel's team began developing several structures and activities for the resilience leaders (RL) program, including UVI's new interdisciplinary degree programs and the planned UVI Center for Resilience and Sustainability.

Informal Learning

The informal learning team is led by Jarvon Stout and despite the impacts of the pandemic, the component successfully worked with both internal and external partners by utilizing innovative technology to coordinate engagements fitting a virtual and/or hybrid model. These engagements were geared towards community engagement, k-12 outreach and citizen science.

Working alongside community partners and through numerous collaborations, the IL team engaged approximately 1,300 USVI residents in year 1. Some 1,200 community members viewed/attended two virtual Science Saturday events that focused on current VI-EPSCoR-funded mangrove restoration and coral disease monitoring research. A total of 54 public volunteers attended the St. Thomas Great Mangrove Cleanup, held in April of 2021.

IL continued its relationship with the after-school STEM program University Bound (UB) and with the Virgin Islands Marine Advisory Service (VIMAS) to provide over 80 7th-12th grade students across the Territory with STEM-based learning kits. IL also partnered with VIMAS to create the "Mangrove Spy, USVI" project which aims to document

biodiversity at mangrove nursery sites through “Zooiverse” –a web-based citizen science platform.

Communication and Dissemination

Our communications team, led by Elisa Bryan, completed a complete redesign of the website viepscor.org as part of the introduction of the R2R project to the public. The website will provide an overview of R2R goals and introduce the research areas, team members and collaborators while allowing for expansion of the site as the R2R project develops outputs. The team also completed preparing a magazine-style newsletter that introduces the R2R teams and their components. Both projects are very near completion and the website launch and newsletter printing is expected to commence in early June 2021.

Project Outcomes Report

We are concluding the first year of our Track 1 “Ridge to Reef” project that was initiated during the global COVID-19 pandemic. Due to the public health restrictions, much of our planned research, education and outreach activities were curtailed or postponed. Nonetheless, the use of virtual meeting and communications platforms such as MS Teams and Zoom significantly increased our ability to collaborate, educate and reach stakeholders to the point that we were able to meet many of our Year 1 Strategic Plan objectives.

By serendipity, our remote location in the Caribbean (“end of the eastern US supply chain” for equipment and resources) coupled with the ongoing rebuilding of key research facilities, offices, and classrooms located in our Marine Science Center and Environmental Analysis Laboratory which were severely damaged in the 2017 hurricane season, prompted our team during the proposal preparation of this Track 1 award to focus this first year on recruiting students, postdocs, advance new collaborations, and sorting out logistics for field research plans. These logistics included acquiring research permits from federal and local government agencies, purchasing testing and deploying equipment, and training students and postdocs. We have assurances from the contractors and University that our facilities will be open and operational early in Year 2. The net result is that we have had to make fewer adjustments, or deal with delays or impacts due to the pandemic. Much of our field research will begin this summer of 2021, as we transition from Year 1 into Year 2 of the R2R project.

Significant outcomes include the submission of 20 proposals by the VI-EPSCoR researchers requesting \$15,707,884 in funding of which 5 were awarded for a total of \$3,427,364. During this reporting period, 33 papers and book chapters were submitted for peer review, and 11 have been published and 3 additional papers have been accepted. Research permits for our Watershed Monitoring and Land use, Mangrove and Mangrove Restoration, and Fish Ecology components were all successfully acquired, and permits for the remaining components are in the review and approval stages. Two Postdocs positions have been successfully recruited- one in mangrove restoration and the other in acoustic telemetry- and the hires are expected to begin before the fall of 2021, while candidates for a third postdoc position (watershed dynamics) are under review.

Intellectual Merit

The R2R research project is in its first year of addressing the impacts of changing environmental conditions on small island social-ecological systems. Healthy coastal and coral reef ecosystems are essential components of the tourism-driven economy in the US Virgin Islands. Previous research including earlier NSF-EPSCoR Track 1 projects have shown that the USVI's coral reefs and associated habitats are becoming increasingly more vulnerable to stress drivers such as oceanographic-climatic perturbations, and also to land- and water-based human activities, which often magnify the negative effects of natural disturbances such as the 2017 hurricanes Irma and Maria that devastated the Territory.

The ability of these natural systems to resist and recover from disruptions and activities, drivers of change, is key to their resilience. Understanding and quantifying these drivers is the focus of the "Ridge to Reef" (R2R) project. We will synthesize knowledge about the various factors (including those affected by climate change) that drive degradation, decrease resistance to disturbance, and reduce the resilience of Caribbean coral reef ecosystems. Science-based ecological restoration that emphasizes biological biodiversity will be implemented to complement ecosystem studies that inform the best available management strategies to increase resilience of marine and coastal habitats. The R2R project will also work to develop the next generation of Virgin Islanders to ensure a resilient future for their natural resources - a key element of the dominant tourism-based economy of the U.S. Virgin Islands.

Collectively, this project which incorporates research, education, and community engagement is expected to identify and highlight the multidisciplinary approaches needed to inform small Caribbean island communities and their decision makers of the environmental threats that range from local -such as poor land use practices- to global - such as increased sea level rise and coral disease incidence exacerbated by warmer ocean waters. The research also explores and develops environmental mitigation strategies such as mangrove and coral restoration.

R2R Project Impacts

The R2R project is concluding its first year, so impacts are just beginning to materialize. Coincidentally, the impacts of the pandemic also alter our ability to assess impacts—at least in some of the traditional ways such as quantifying and characterizing participation at outreach events.

However, two areas of research within the R2R project pose real potential for impact – at the discipline level and, more broadly, at the societal level. At the discipline level, Marilyn Brandt's research on coral diseases is providing important insights on the role of coral biodiversity and distribution in resisting environmental stressors such as disease. These insights are critical as we think about steps scientists and natural resource managers might take to mitigate the impacts of climate change or habitat degradation. Coral restoration has to evolve beyond the early practices of planting fast-growing species that can establish easily in new sites to more science-based selection efforts that identify disease resistant or heat tolerant genotypes in a variety of species in order to have longer term success in coral and marine habitat restoration. This research builds on our past understanding of coral disease spread from our previous *Mare Nostrum* Track 1 project. Dr. Brandt and her team have published a number of papers on their efforts that are influencing and advancing coral reef management strategies nationally and internationally.

Our programs in education and workforce development, led by Lawanda Cummings focuses on promoting STEM learning in both formal and informal spaces in the USVI. This work is critical in the development of an empowered STEM workforce for the future. The formal learning component that focuses on Teacher Professional Development is emerging as one of the more impactful areas of the R2R project with key societal benefits. The public schools in the USVI are, based on the metrics of standardized test performances by their students, underperforming. One factor, among many, is teacher preparation and training. The R2R project is building off of our previous *Mare Nostrum* Track 1 project by training teachers in innovative STEM teaching techniques, effective use of educational technology, and integrating locally and culturally relevant science content (R2R environmental research) into curricula. Three of the last four Territory-wide “teacher of the year” awards have gone to teachers who have participated in our teacher professional development program. Dr. Cummings and her team are collecting data in the R2R project where we anticipate improved teachers’ STEM efficacy translating into stronger STEM identities among their students. This potentially has significant long term beneficial impacts for our future workforce in the

USVI. Our current workforce is highly dependent on a tourism-based economy that is too vulnerable to externalities such as pandemics that, in turn, dramatically reduce the number of visitors. The islands' economy needs to diversify in order to withstand the economic disruptions that are increasing in their frequency in the Caribbean region.

SYNOPSIS: Watershed and Land Use

Research Lead: David Hensley

The Watershed and Land Use research area made important progress in its three overall goals. Towards the first goal (WL1: Identify sediment flux sources via sediment fingerprinting, and nutrient flux and microbial flux monitoring to characterize the role of runoff in two Virgin Islands watersheds), the sediment trap prototype was built and tested for field implementation by the end of Year 1. All study site locations were scouted and geo-tagged for geospatial analysis, and initial site data, including soil sampling, was also undertaken. Major equipment for use in sediment fingerprinting was purchased and is being calibrated for sediment source tracking.

Progress was also made in the second goal (WL2: Estimate the downstream impact and ecosystem services rendered by conservation land use interventions). All field sites were geospatially defined and analyzed using GIS software, and initial field data, including soil samples, were taken. A plantain ground cover experiment monitoring rainwater infiltration was also established with the planting of 726 plantain plants in the field.

In the third goal (WL3: Share communication, community education, and integration activities to support public and stakeholder benefit of the land use research), an undergraduate student research assistant was hired in March 2021 to assist with project implementation, and an offer was made and verbally accepted for a master's student assistantship on the Watershed and Land Use team to begin in Fall 2021. A job advertisement was also posted for the postdoctoral fellow position to be filled in Year 2, and applicants will be reviewed in May. Outreach and communication activity, including the drafting of a newsletter entry, appearance on a virtual UVI radio show for Virgin Islands audiences, and a presentation at a scientific conference were completed as well. As of this writing, it is expected that members of the Watershed and Land Use team will also help facilitate a field experience for students slated to take place in May or June of 2021. For all goal areas, the necessary permits from landowners, agencies, and regulatory bodies, were secured.

Major Accomplishments and Research Findings

Watershed and Land Use

Goal WL1

Significant progress has been made toward Goal WL1, and we expect that by the end of the Year 1 period, all WL1 objectives will be accomplished.

As of mid-April 2021, all necessary permits from federal, local, and private entities to conduct research on public and private lands were granted or were expected to be granted (pending final approval by National Park Service, Virgin Islands National Park, but the project has been approved in principle as of April 2021). This includes the permitted use of a native secondary forest owned by the Virgin Islands Department of Agriculture, secondary forests, agroforestry production orchards, vegetable cropping areas, and unpaved road sections on two working farms on the island of St. Croix, land-based and underwater study activities at the Salt River Bay National Historical Park and Ecological Preserve (NPS), and general permits for this study in the wider U.S. Virgin Islands obtained from the Virgin Islands Department of Planning and Natural Resources. (Obj. WL1.1b & Obj. WL1.2b)

In addition, study areas have been physically ground-truthed and geo-tagged, with initial GIS site characterizations completed in terms of watershed catchment areas, upslope areas of study points, and delineation of expected streamflow areas at the subcatchment scale. In February 2021, team lead David Hensley extensively scouted the Fish Bay watershed with Fish Ecology team lead Rick Nemeth and identified study sites within the gut which are both hydrologically and ecologically appropriate for sediment and water sampling and periodic streamflow data collection. Throughout both Salt River and Fish Bay watersheds, sites for reference sample collection have been geo-tagged, and reference sample collection is planned to proceed in the month of May (Obj. WL1.1b & Obj. WL1.2b).

Prototyping of protocols and custom equipment for sediment trap designs is ongoing as of this writing, but progress has been considerable and is expected to be completed on time before the end of Year 1 and before the onset of the peak rainy season of 2021. A modification of the Philips design of time-integrated suspended sediment samplers for riverbeds is under development for use in ephemeral dry streambeds (guts) in Virgin Islands watersheds, and a prototype has been constructed which is undergoing tests for acceptable accuracy before deployment in the field. Protocols are also being developed

for the installation and purging of these devices during the prototyping process, and these will be complete at the time of deployment, expected in May 2021 (Obj. WL1.1a). Material for the sediment traps have been purchased, and weather stations and water level loggers have been ordered and delivery is expected between May and June 2021 for installation at the end of the grant year before the onset of regular rain in approximate July 2021. The UV-Vis spectrophotometer which will be used in sediment source tracking has been delivered and will be calibrated for reference sediment samples in the coming days (Obj. WL1.1c). Water analysis protocols have also been developed for nitrate and phosphate detection in water samples collected from the two study watersheds for nutrient flux estimates, and necessary supplies have been identified for purchases to be made in May 2021. A collaboration with another research team (non-EPSCoR, territorial funded) was established in March 2021 to cooperate on Salt River hydrological data collection and sediment sampling during the 2021 rainy season, because this team is also engaged in a watershed analysis of Salt River and several other Virgin Islands watersheds for 2021. Water sampling protocols will be harmonized with this team to the extent possible to allow for a greater collaboration and cooperation (Obj. WL1.2a & WL1.2d)

The protocol and designs have been developed with sufficient detail that a plan with other teams for sediment sampler collection has been developed for Fish Bay, while key personnel are present on St. Croix island for sampler collections at Salt River. Sampling in guts will occur on an ad hoc basis in response to water levels sustained above sampler depth for longer than one hour at an interval to be determined by the average capacity of the samplers, likely several weeks. Sampling on hillsides and in underwater sediment traps will occur in reasonable synchronization with the gut sampling for more direct comparison between discrete rain events (Obj. WL1.1e).

Goal WL2

Goal WL2 involves three separate field studies tracking the effect of ground covers and land uses on runoff, infiltration, and sedimentation downslope. All three studies have been physically established, and equipment has been purchased and/or assembled as of this writing, and will be installed in the field by the end of Year 1.

Agreements have been reached with landowners for the Before-After Control-Impact conservation buffer study to install sediment traps at five locations in northwestern St. Croix. These sites have been scouted and geo-tagged for topographic analysis, and the sediment trap design has been finalized. Site visits to install these sediment traps are

expected in mid-May 2021 (WL2.1a), allowing for a preliminary sampling before the end of Year 1, and in response to any rain event before the end of the grant-year (WL2.1b). No samples have yet been processed in this study because no significant rainfall has occurred to produce sedimentation to analyze, but the mid-May timeline for sediment trap installation is expected to precede the onset of major rain in the Virgin Islands for 2021 (WL2.1c).

In the breadfruit agroforestry landscape study with paired reference forests, all required permits from landowners and local government agencies have been secured. Monitoring equipment (soil moisture data loggers, weather stations, and rain gauges for canopy interception of precipitation estimates) has been purchased but has not arrived as of this writing, and will be installed immediately upon arrival (WL2.2a). Soil samples have been collected from all eight study fields, for a total of 108 samples, which have been color-classified and physically processed for gravimetric moisture content and chemical lab analysis, but these samples have not yet been submitted to lab for chemical analysis (WL2.2b & WL2.2c). A series of hydrological and soil maps for these study landscapes are underdevelopment in GIS applications and will be paired with actual soil data collected during Year 1 for preliminary analysis before the end of the grant-year (WL2.2d). Walking transects have been established for seasonal observations of changing canopy cover, tree height, stand density, and other basic covariates of interest for comparative analysis with soil data and runoff estimates.

The plot-scale living mulch/ground cover supporting experiment in plantain has been fully planted as of this report, and organic mulch and living ground cover will be laid in May 2021 after plants have become established (WL2.3a). A total of 726 plantain covering 0.16 hectares are now under observation in this experiment, and soil samples have been collected from all plots (total of 18 samples), and have been processed for color, texture, pedogenesis, and gravimetric moisture, but have not yet been chemically analyzed by a lab (WL2.3b & WL2.3c). Similarly to the field-scale breadfruit/reference forest landscape study, spatial analysis and maps of these preliminary data are being produced currently, and will be completed and analyzed by the end of Year 1 (WL2.3d).

Goal WL3

Goal WL3 involves the engagement of the scientific community and general public in the research activities of the Watershed and Land Use team, and intended objectives and deliverables for this goal in Year 1 were attained satisfactorily.

Photographs and essay text were written in collaboration with other teams for the R2R newsletter, which is expected to be published soon (WL3.1b). No official sponsored opportunity to share a presentation or lecture has occurred so far in Year 1, but David Hensley appeared on a UVI radio show produced by the School of Agriculture communication team to be interviewed about the Watershed and Land Use research in the R2R project in March 2021 (WL3.1c)

Also in March 2021, a UVI undergraduate student, N'Quoia Christian, was engaged in a paid research opportunity on our research team. Since that date she has actively participated in the prototyping of suspended sediment samplers, has participated in field scouting visits, and has assisted with the establishment of the plantain living ground cover experiment (WL3.2a).

In April 2021, David Hensley attended the virtually-hosted International Tropical Islands Water Conference, hosted by the University of Hawaii. Hensley gave a presentation titled "Making water flow again: The case of the St. Croix aquifer and the future of freshwater resources in the Virgin Islands," detailing the expected results of the Watershed and Land Use research team's efforts as they relate to freshwater issues in the Virgin Islands (WL3.3a). Though preliminary abstracts for all ongoing research has not yet been completed, substantial drafts of materials and methods sections for future manuscripts submitted for publication have been drafted as part of the protocol development and prototyping process (WL3.3b). We feel this is a more appropriate outcome of Year 1's efforts due to the need for rainfall to produce interpretable data for most of our experiments and monitoring studies.

**SYNOPSIS: Mangrove Ecosystem Function & Recovery
and Mangrove Restoration**
Research Lead: Dr. Kristin Wilson Grimes

The Mangrove Ecosystem System Function & Recovery and Mangrove Restoration is led by Dr. Kristin Wilson Grimes and includes Research Technician, Allie Durdall. In Year 1, this theme made significant progress towards its three goals: (1) investigate current and historic USVI mangrove distribution, recovery, and loss, (2) grow USVI mangrove restoration opportunities, and (3) share USVI mangrove research with stakeholders and provide opportunities for new partnerships. Key accomplishments include compilation of aerial images and other historical documents to document current and past mangrove extent, successful application for and receipt of all territorial and federal research permits needed for this work, fieldwork methods defined and started, construction of land-based and nearshore wet nurseries, and support for UVI undergraduate and graduate students. In Year 1, this area had 2 peer-reviewed journal articles that are in-press at the time of this report and 2 more that are in-review. This group gave 8 oral presentations at local, national, and international conferences. In this reporting period, a total of 7 proposals were submitted with 3 successfully awarded, 3 pending, and one declined. Four of these proposals are directly related to expanding R2R mangrove research objectives. One graduate student (K. Schlender) successfully completed her thesis within the Master's of Marine and Environmental Science program in December 2020. Four UVI graduate students and two undergraduate students have been recruited to work on this theme's research and restoration goals this year. The Mangrove Restoration postdoctoral position was created, advertised, first and second interviews conducted, and the position offered to a top candidate. The candidate verbally accepted; this hire is expected to be completed by the end of Year 1.

Major Accomplishments and Research Findings: Mangrove Ecosystem Function & Recovery and Mangrove Restoration

This research team is led by Dr. Kristin Wilson Grimes and assisted by Marine & Watershed Specialist, Allie Durdall. The team has made significant progress in Year 1 in each goal, objective and strategy, as described below.

Goal M1. Investigate current and historic USVI mangrove distribution, recovery, and loss.

The Grimes lab is the process of compiling aerial images and other historical documents that show past mangrove extent (M1.1a, M1.1b). We have met with different stakeholders to gather this information including individuals from the Virgin Islands Department of Planning & Natural Resources Division of Coastal Zone Management, the Virgin Islands National Park, the U.S. Geological Survey (USGS), UVI librarians, and individuals from local historical societies on each of the islands. We have also searched publicly available images and other sources. We've created a database documenting the year, source, and description of each resource we've found to-date and will continue to add to this as new resources are identified (M1.1d).

We have identified priority mangrove sites for drone imagery acquisition (M1.1c) and have investigated the steps needed to obtain the proper licensure and accreditation to legally fly in the different air spaces of the USVI. We have started this process and once obtained, will apply for additional National Park permits to fly drones in those areas. Territorial permitting requires us to obtain these certifications before any imagery acquisition can begin. This has delayed planned drone surveys, mapping, and analyses for Year 1 (M1.2c, M1.2d, M1.2e). We explored whether we could collect these data through a partnership with VI DPNR CZM, but unfortunately, they also do not have the necessary certifications at this time, although they expressed interest in partnering to assist with monitoring fieldwork.

Research sites were identified and finalized in coordination with other R2R research areas (Fish Bay, St. John and Salt River, St. Croix; M1.2a). All territorial and federal permits needed for research and restoration that can be submitted at this time, have been; all new territorial permits (1), territorial permit amendments (1), and new National Park permits (2 of 2) have been approved. (M1.2b, M2.1a). Rapid assessment and long-term monitoring methods to document current mangrove status were developed in

consultation with the USGS and all equipment needed to conduct these surveys and monitoring, ordered (M1.2f, M1.2g). Fieldwork will begin in April 2021 (M1.2f, M1.2g, M1.2i). Equipment needed for lab analysis of field samples was also ordered (M1.2i), and logistical preparations were made to accommodate lab analysis on the St. Thomas UVI campus despite ongoing construction in the Environmental Analysis Laboratory.

Goal M2. Grow USVI mangrove restoration opportunities.

The Grimes lab made significant progress investigating mangrove nursery methods, including wet- and dry-land nursery options and grow-out practices. This was accomplished by researching other Florida-Caribbean mangrove nurseries and gathering information through unpublished sources, including web and blog posts, websites, and newspaper articles, and through meetings with restoration practitioners across the region, including one meeting and virtual nursery tour with individuals from the H. Lavity Stoutt Community College in Tortola (M2.1b, M2.3a). The Grimes Lab compiled a list of Caribbean-basin restoration projects and contacts as a project resource moving forward.

Two wet nurseries have been constructed and planning for the dry nursery has started (M2.1b). All materials for these have been ordered (M2.1b). Passive, nearshore grow-out structures have been constructed with the help of current MMES students in the Grimes lab for deployment in the lagoon by UVI MacLean Science Center. These are modelled after similar structures used in the British Virgin Islands and will be used to test the efficiency of in situ propagule growth versus controlled, experimental conditions in the plumbed wet-nursery. The plumbed wet nursery was constructed this spring and includes 8 tables with 24, 45 gallon tanks, each plumbed for fresh and saltwater. This was a significant undertaking by Grimes, Durdall, and students of the Grimes lab and is a significant Year 1 accomplishment.

Two propagule selection sites (Magen's Bay and the St. Thomas East End Reserves) were identified (M2.1c), however, we have learned that mangrove phenology is not well-constrained for mangrove species of the USVI and that additional information is needed to aid efficient propagule collection for restoration efforts. Therefore, our team has created a new phenology data collection protocol created and tested for suitability for citizen science use with partner, the Virgin Islands Marine Advisory Service (VIMAS). Starting in March, we began collecting phenology information and employed the revised protocol beginning in April. We plan to conduct routine phenology surveys for St. Thomas sites to better constrain species- and/or site-specific phenology and to

understand how these may change over time. This is a key piece of information as our territorial permits require the collection of adventitious propagules (those dropped from the parent tree), so there is a small window for collection (M2.1c). We have collected our first red and white mangrove propagules and transported them to the nursery at UVI.

Two sets of grow-out experiments have been designed and planned for *Rhizophora mangle*, as part of Allison Holevoet's Masters thesis. These experiments will test how salinity, light, and clumping, impact propagule growth (M2.1d).

Grimes and Durdall met twice with Jarvon Stout (VI EPSCoR Community Engagement Specialist; R2R Informal Learning) and Howard Forbes, Jr. (VIMAS) to learn about St. Thomas mangrove restoration efforts to-date, share mangrove nursery plans, and discuss citizen science program goals (M2.3a). Grimes has also started discussions with the citizen science external evaluator, Karen Peterman.

The Grimes Lab has also explored other opportunities to support mangrove restoration program development, including a visit to St. John to explore planned plant grow-out and restoration sites with Dr. Gary Ray and a virtual tour of the BVI nursery on Tortola with Dr. Liana Jarecki and Susan Zaluski from the H. Lavity Stoutt Community College. Grimes has continued communications with Dr. Caroline Rogers (USGS), Dr. Ken Krauss (USGS), Dr. Anna Toline (National Park Service), and Kristen Ewen (NPS), regarding opportunities and coordination with the NPS Mangrove Restoration Plan at sites on St. John and St. Croix. With Dr. Marilyn Brandt, Grimes submitted a scope of work to the NPS to expand mangrove and coral restoration and coral disease response for just over \$2M in April 2021. If awarded, this will provide additional funding for mangrove restoration at the Salt River site and additional funding for an MMES graduate student. Also this year, Brandt (PI) and Grimes (Co-PI) were awarded a FEMA Hazard Mitigation grant funded by VITEMA in the amount of \$619,805 that will significantly expand coral and mangrove restoration activities in the territory, bolstering R2R efforts. For mangrove restoration, this includes some monies to better understand across island and site-specific mangrove genetics, which are currently largely unknown and may be critical to restoration goals (M2.3a).

Grimes (PI) and Brandt (Co-PI) were also part of the successful proposal entitled, "Strengthen Coastal Resilience in the US Virgin Islands through Coral Reef Restoration," to the National Fish and Wildlife Foundation, National Coastal Resilience Fund that was awarded this spring (\$1,829,808 total; \$237,455 sub-award to UVI). The

Nature Conservancy (TNC) is the lead institution. This grants strengthen partnerships between UVI and TNC, contributing to coral restoration efforts across the territory. Specifically, it provides tuition and stipend support for a UVI MMES graduate student and a new Workforce Fellow position focused on coral restoration, through the SEAS Islands Alliance. Shamoy Bideau, a UVI undergraduate from St. Croix and former SEAS undergraduate student, has been accepted to UVI's MMES program and recruited for and accepted this new RA. Grimes is the PI for the NSF INCLUDES SEAS Islands Alliance (Co-PI, Brandt) which works to broaden participation in the geosciences from pre-college to to the workforce in the USVI, Puerto Rico, Guam and Micronesia (Award #1930991).

With Dr. Sennai Habtes and Dr. Marilyn Brandt, Grimes also submitted a collaborative proposal to NSF Coastlines and People program, entitled, "Large-Scale CoPe: Connecting Communities and Co-Innovating Nature-based Solutions to Reduce Storm Exposure and Social Vulnerabilities" (lead, University of South Florida \$20M total; \$2.5M subaward to UVI). If funded, this work will expand mangrove and coral restoration efforts in the territory and expand learning and sharing with communities in Florida and Belize.

Grimes chaired the hiring committee for the Mangrove Restoration Post-Doc, of which Durdall is member. Responsibilities included assembling the hiring committee, writing the position description, sharing it with professional networks, writing interview questions, reviewing candidates, organizing first and second interviews with top candidates, and recommending a candidate for hire. Of 13 applicants, three were interviewed and the top two invited for second interviews. An offer was made to a top candidate who verbally accepted the position; we expect the position to be successfully hired with a start date in summer 2021. This was another significant accomplishment achieved in Year 1 that will build capacity within this research theme.

Goal M3. Share USVI Mangrove Research with Stakeholders & Provide Opportunities for New Partnerships.

The Grimes Lab has committed to sharing mangrove research and restoration activities in several key ways in Year 1 of R2R, including the development of website content and newsletter items for VI EPSCoR (M3.1a, M3.1d, M3.1e). Collectively, the Grimes Lab has co-created a draft Mangrove Kids Activity Book that it will share with formal and informal science educators for feedback and revision by June 2021 (e.g., VI ISERP teachers and individuals who are part of the Virgin Islands Network of Environmental

Educators). This initiative has been led by Durdall with support from SEAS Islands Alliance Workforce Fellow, Zola Roper, and with input from all members of the lab. The activity book will highlight USVI-specific, mangrove information in culturally-appropriate and fun ways for elementary-aged kids and is modelled after two other books the team has created focused on marine debris and hurricane preparedness.

The Grimes lab engaged the public in the 2021 St. Thomas Great Mangrove Cleanup in Red Hook on April 24, 2021, in support of Earth Day activities occurring throughout the territory (M3.1b). This event was promoted on social media with the assistance of VI EPSCOR and SEAS Islands Alliance Workforce Fellow, Zola Roper (M3.1a) and is made possible through additional funding from NOAA's Marine Debris Program. This effort was led by Grimes in collaboration with Durdall, as well as many other territorial partners (Kitty Edwards, VI DPNR CZM; Leslie Henderson, NOAA; Howard Forbes Jr., VIMAS; Elisa Bryan VI EPSCoR; Jaron Stout, VI EPSCoR; Avia Huisman, UVI; Zola Roper, UVI).

Grimes actively contributes to natural resource management in the territory relevant to mangroves. For example, she gave an invited talk about her mangrove research in the St. Thomas East End Reserves (STEER, a marine protected area on St. Thomas) at the STEER Management Workshop in February 2021 and is actively contributing to the revision of the STEER Management Plan including its vision, mission, and goals. She also leads a NOAA-funded effort to co-create the territory's first Marine Debris Action Plan with stakeholders.

The Grimes Lab has provided opportunities for student training (M3.2a, M3.2b). Four MMES graduate students have been recruited to work on UVI Masters theses related to mangrove research and restoration goals. Stephanie Hibberts, a second year MMES student started an EPSCoR RA in the Spring 2021. Her work will document mangrove recovery since the 2017 storms through rapid assessments at 16 sites across the territory. She is also assisting with the compilation of images and other historical documents as part of the mangrove change over time analysis. Two first year MMES students, Allison Holevoet and Kayla Halliday, will focus on testing different red mangrove grow-out best practices in support of R2R mangrove restoration goals. Allison was also selected as an NSF NRT Strong Coasts Fellow (Award #1735222) for which Grimes is a CO-PI. Kayla grew up on St. Thomas and completed her undergraduate degree at UVI in Marine Biology. She took a leave of absence at the end of the first semester for personal reasons, but has remained engaged with the lab through biweekly meetings and plans to return to the program in Fall 2021. New URM student,

Laura Palomino, was recruited to the Grimes lab in Spring 2021 using a mangrove restoration RA and will begin in the MMES program in Fall 2021. In addition, second year student, Kelsey Vaughn, has almost completed her fieldwork investigating the characterization and impacts of the invasive seagrass, *Halophila stipulacea*, on carbon storage at depth, contributing to that R2R emerging research theme (M3.2b). Finally Kaliegh Schlender, who was advised by Grimes, successfully defended her Masters thesis entitled, “Beach Morphology and Anthropogenic Impacts on Ghost Crab Populations, St. Thomas, USVI” and graduated in December 2020. She has taken a Scientists in the Parks (SIP) position with the National Park Service in the Dry Tortugas starting in May 2021.

Two UVI undergraduate students have been identified, interviewed, and matched to work in the Grimes lab for Summer 2021 (M3.2a). Both identify as black women and both will also participate in the NSF-funded SEAS Islands Alliance (Award #1930991) programming scheduled for this summer, leveraging programming activities across awards. They will work to support mangrove research and restoration activities.

The Grimes Lab has participated in national and international virtual conferences (M3.3b). Grimes and Durdall participated in the International Tropical Islands Water Conference, focused on tropical island water futures (water for people and ecosystems in the face of change), held April 12-15, 2021 and co-sponsored by the Virgin Islands Water Resources Research Institute and Hawaii EPSCoR, among others. In her role as the Director of the Virgin Islands Water Resources Research Institute, Grimes assisted with conference program development for this virtual conference, abstract review, session moderating, in addition to giving a presentation entitled, “SEAS Islands Alliance: Broadening Participation in the Geosciences in the U.S. Virgin Islands, Puerto Rico, and Guam through Pathway Programming and Island Networks.” She also presented at the 2021 Conference on Island Sustainability organized by the University of Guam, the American Geophysical Union Fall Meeting, the American Meteorological Society Annual Meeting, and the NSF-funded National Research Traineeship Marine/Coastal Summit. Grimes also supported 3 UVI undergraduate and 5 MMES graduate students to participate in the SACNAS 2020 National Diversity in STEM Conference in October 2020.

Grimes was also a participant and invited speaker for the NSF-funded Convergence Accelerator Workshop, Smart Oceans in October 2020. Her invited lightning talk, “SEAS Islands Alliance: Expanding Opportunities for Islands Students in the Ocean Sciences,” had more than 1,700 views as of 10/9/2020. She also participated in the

invitation-only workshops on Wednesday, October 7 and the closing session on October 9 (900+ registered participants, 400+ institutions), where she shared insights about R2R research and broadening participation efforts in the USVI.

Grimes and Durdall are actively working to increase diversity, equity, and inclusion in geosciences spaces and to increase their knowledge on these topics. In February 2021, they co-organized a one-hour long session with Dr. Doug Parker on “Diversity, Equity, and Inclusion,” for the National Institutes of Water Resources 2021 Annual Meeting. Grimes also is the chair of the newly-formed Diversity, Equity, Inclusion, and Justice Committee for NIWR and co-chairs the Broadening Participation Council for the Coastal & Estuarine Research Federation. In that role, she is also the Co-PI for CERF’s Rising TIDES (Toward an Inclusive, Diverse, and Enriched Society) Conference Program, funded through an NSF GOLD-EN awarded in January 2021 (Award #2036515).

Grimes and Durdall are also participants in the NSF-funded program, Unlearning Racism in the Geosciences (URGE). The primary objectives of URGE are to, “(1) deepen the community’s knowledge of the effects of racism on the participation and retention of Black, Brown, and Indigenous people in Geoscience, (2) draw on existing literature, expert opinions, and personal experiences to develop anti-racist policies and strategies, and (3) share, discuss, and modify anti-racist policies and strategies within a dynamic community network and on a national stage.” They are participating in a pod from the SEAS Islands Alliance, in eight, two-week sessions from January to May, 2021, meeting to discuss readings, interviews, and program deliverables. In addition, Grimes participated in the Cultural Competency & Inclusion Workshop organized by the Florida-Caribbean Louis Stokes Regional Center of Excellence last fall (September 17, October 15).

In July 2020, Grimes led a multi-institution proposal effort, entitled, “Diversity, Equity and Inclusion Capacity Building Program for Conservation Organizations,” to the Doris Duke Charitable Foundation which would have shared culture audit tools developed by the SEAS Islands Alliance with partners from The Nature Conservancy in the USVI, Puerto Rico and Guam. Ultimately, this proposal was not funded. In February 2021, Grimes submitted with PI Mon Behl (University of Georgia Sea Grant), “A JEDI (Justice, Equity, Diversity, and Inclusion) Climate Alliance to promote health equity and build resilience in the Southeast United States and Caribbean Regions,” to NOAA’s Climate Program Office Regional Integrated Sciences and Assessments Program. This proposal is pending at the time of this report.

Grimes was selected for the Jackson State University Summer 2020 Virtual Writing Group funded by the NSF ADVANCE Program (third time participating; also participated in 2016 and 2018). She was one of 35 women selected; 1 of 7 at UVI and participated in weekly meetings during Summer 2020. She also participated in the JSU Winter 2020-2021.

Grimes co-authored two papers that are in-press at the time of this report and two that are in-review, * indicate UVI MMES student author:

- Harris, L., T. Grayson, H.A. Neckles, C.T. Emrich, K.A. Lewis, K.W. Grimes, S. Williamson, C. Garza, C.R. Whitcraft, J. Beseres Pollack, D.M. Talley, B. Fertig, C.M. Palinkas, S. Park, J.M.P. Vaudrey, A.M. Fitzgerald, J. Quispe. A socioecological imperative for broadening participation in coastal and estuarine research and management. In press, *Estuaries & Coasts*.
- L. Harris, C. Garza, M. Hatch, J. Parrish, J. Posselt, J. Alvarez, E. Davidson, G. Eckert, K. Grimes, J. Garcia, R. Haacker, M.C. Horner-Devine, A. Johnson, J. Lemus, A. Prakash, L. Thompson, P. Vitousek, M.P. Martin, K. Reyes. Equitable Exchange: A framework for diversity and inclusion in the geosciences. In press, *AGU Advances*.
- S.V. Costa*, S.J. Hibberts*, D.A. Olive*, K.A. Budd*, A.E. Long*, S.S. Meiling, M.B. Miller*, K.M. Vaughn*, C.I. Carrión*, M.B. Cohen*, A.E. Savage*, M.F. Souza*, L.Buckley, K.Wilson Grimes, R. Platenberg, T.B. Smith, J. Blondeau, M.E. Brandt. Diversity and Disease: The effects of coral diversity on prevalence and impacts of stony coral tissue loss disease in Saint Thomas, U.S. Virgin Islands. In review, *Frontiers in Marine Science*.
- R.S. Ennis, K.Baltzer, J.Jossart, M.Sevier, J. Kisabeth, H. Forbes Jr., K. Tennant, M. Rios, .Brandtneris, M.E. Brandt, T.B. Smith, K.Wilson Grimes. Persistent water quality impairment negatively impacts red mangrove (*Rhizophora mangle*) prop root epibiont communities in a marine protected area of St. Thomas, U.S. Virgin Islands. In review, *Marine Pollution Bulletin*.

Grimes also leads the USVI Storm Strong Program, a community-based hurricane preparedness program, and the Virgin Islands Water Resources Research Institute, which secures USGS funding for fresh water related research and education projects. Grimes has one other pending proposal not previously mentioned in the narrative, at the time of this report (listed below). In addition, she intends to apply for supplemental funds through the NSF Dear Colleague Letter, "Supplemental Funding for Postdoctoral Researchers to Mitigate COVID-19 Impacts on Research Career Progression" (NSF 21-066) in support of her current NSF INCLUDES award (#1930991).

- “Cays to Conservation, Marine Debris in the U.S. Virgin Islands.” PI, Kristina Edwards, U.S. Virgin Islands Department of Planning and Natural Resources, Co-PI Kristin Wilson Grimes. \$144,163 total; \$80,017 subaward to UVI.

SYNOPSIS: Emerging Areas - Seagrass & *Sargassum*

Research Lead: Dr. Edwin Cruz Rivera

Emerging research on seagrass and *Sargassum* during year 1 recruited and advised three new or continuing graduate students, recruited an M.S. student (starting Fall 2021) through an external collaboration with University of Alabama Birmingham, and recruited a Ph.D. student (starting Fall 2021), through a second collaboration with Drs. Greg Guannel (UVI) and Brett Webb (University of South Alabama). Students at UVI are currently developing field and laboratory methods to begin their graduate research after successfully completing required core courses. This research will engage in characterizing the patterns of palatability of the invasive seagrass *Halophila stipulacea*, its relation to the distribution of the commercially important queen conch, and the effect of *Sargassum* accumulations on beach detrital fauna. The latter will expand on the ongoing collaboration with Dr. D. Christopher Rogers from the Kansas Biological Survey, which has already produced a manuscript currently under review. Research on seagrass through this R2R has stimulated other external collaborations and a Memorandum of Understanding with North Carolina Central University (another HBCU) is currently under development to support exchange between Project Lead Cruz-Rivera and Dr. Omar Christian's groups. Dr. Christian will be characterizing secondary metabolites of the invasive seagrass *H. stipulacea* and advising chemical aspects of graduate student Jendahye Antoine's M.S. thesis. At present two of four collection permits requested have been granted for the research and equipment has been ordered. Due to COVID-19 restrictions, the sampling of seagrass-associated fauna will begin in summer 2021. Two proposals expanding on R2R emerging research have been submitted during this period. Two talks in research symposia have been presented as well. The research on seagrasses by the Cruz-Rivera group was highlighted during a local radio interview with the project lead and his students.

Major Accomplishments and Research Findings: Emerging Areas - Seagrass & Sargassum

Advances were made during the first year in the areas of feeding ecology. Planned laboratory experiments of seagrass growth under controlled conditions (EA 3.2) have been curtailed by delays in the available facility space and field experiments and samplings have been restricted by COVID-19 restrictions.

Goal EA 3: Measure the spread of the invasive seagrass *Halophila stipulacea* in the territory and the mechanisms affecting its expansion.

Graduate students Matthew Sousa and Jendahye Antoine were recruited under this R2R goal (EA 3.1d and EA 3.3.c). Due to COVID-19-related restrictions, his diving certification process was stopped and he is in the process of finishing it. This work will begin during Summer 2021. Collection permits for Sousa were approved (EA 3.1a) and preliminary shallow transects assessing invertebrate (conch species) densities have begun using snorkeling (EA 3.4a) and will continue until diving certification is finished. The PI and student have initiated a collaboration with the VI Department of Fish and Wildlife's SEAMAP-C (South East Area Monitoring and Assessment Program – Caribbean) to maximize sampling efforts for conch. The techniques used for territorial queen conch surveys are completely different to those used in this R2R, and we have agreed to share comparative data that will allow an evaluation of effectiveness of the two approaches. A meeting between Cruz-Rivera and Sousa (UVI), and Christina Carter and Danielle Olive (SEAMAP-C) occurred on April 20, 2021.

Various types of feeding experiments will be conducted Summer 2021 as part of Jendahye Antoine's M.S. thesis (EA 3.3c). She has just finished her course requirements and will be formally conducting research. She has also been shadowing and helping graduate student Madyson Miller, who is using similar techniques addressing intraspecific patterns of seagrass palatability as part of the PI's EPSCoR Track 4 grant. Part of Jendahye's work (EA 3.3.b, Year 2) will include searching for potential chemical defenses in the invasive seagrass *Halophila stipulacea*. To maximize the probability of success in this component, the PI has officially established a working collaboration with Dr. Christian Omar, a natural products chemist at North Carolina Central University (an HBCU). Using this collaboration, Drs. Cruz-Rivera and Omar have drafted a Memorandum of Understanding between the two involved universities to allow for researcher and student exchange between the institutions.

Due to UVI's restrictions in the ability to have undergraduate students on the ground as a result of the pandemic, no undergraduates were recruited and trained as planned. However, the university plans to resume in-person teaching for fall 2021 and research opportunities for undergraduates under this R2R component will be offered then. One proposal (EA 3.2d) is in development with Elizabeth Whitman (Florida International University)

Goal EA 4: Analyze the effects of Sargassum golden tides on Virgin Islands ecosystems.

A collaboration between Cruz-Rivera and Dr. Stacy Krueger-Hadfield (University of Alabama, Birmingham) began. The central goal is to study the genetic diversity of *Sargassum* causing golden tides (EA 4.1). Although COVID-19 travel restrictions delayed the start of this component, sampling protocols have been developed (EA 4.1.a) and graduate student Anna Smith was recruited to begin in Fall 2021 (EA 4.1b). Given that Dr. Krueger-Hadfield and her student could not travel during year 1, the genetic sequencing protocols are being optimized with samples collected and sent to Alabama. Current plans are for the Alabama group to travel to St. Thomas in September, 2021. Blog entries for EPSCoR, TIME, and AGA (EA 4.1d) blogs will follow after this research outing. The second collaboration, with Dr. D. Christopher Rogers (Kansas Biological Survey and the Biodiversity Institute, University of Kansas) spans both seagrass and *Sargassum* work because it is focused on assessing the biodiversity of invertebrates associated with these resources (EA 3.4 a & b; EA 4.2b). One publication, assessing the status of aquatic invertebrate knowledge for the USVI is under review:

Cruz-Rivera, E. and D. C. Rogers. Submitted. An unavoidably short history of inland aquatic animal diversity research in the US Virgin Islands. *Aquatic Sciences*.

Although the assessment of beach biota and how it is influenced by *Sargassum* accumulations using pitfall traps is projected to begin in year 3, graduate student Tiffany del Valle was interested in pursuing these questions as part of her thesis. Thus, fulfillment of this grant goal has begun earlier than projected.

SYNOPSIS: Emerging Areas- Brewer's Bay Acoustic Array

Research Lead: Dr. Paul Jobsis

The installation of the Brewer's Bay fine-scale positioning system acoustic array is scheduled for year two of this award. So no research findings have been made at this point. However, several major accomplishments can be reported. MMES students Andrew McGregor and Taylor Brunson (matriculated 2021) have been selected to work on this project. MMES student Matt Souza has been approached, but has not committed to this project. Donations from three benefactors have allowed the expansion of the Brewers Bay array to include reef areas known as resting location for green sea turtles and fish that are often found in the seagrass beds. The total donations are approximately \$100,000 although not all of which will be associated directly with the acoustic array. Most is to support students who will be working with Dr. Jobsis and assisting or working directly with the Brewers Bay array. Weekly swimming surveys have been conducted and conclude that the seagrass meadows of Brewers Bay still contains a large number of green sea turtles with over 20 sea turtles being seen during the 30 minute surveys. The design of the fine-scale positioning array has been accepted (figure EA1.1b) and ordering the equipment is on schedule to be completed by May 15th of 2021. All permits have been submitted and expected to be awarded by July 1st, or a contingency plan is in place if they are not awarded. Finally the post-doctoral position in movement ecology has been advertised and closed. A finalist has been selected and the hiring process is underway.

Major Accomplishments and Research Findings: Emerging Areas - Brewers Bay Acoustic Array

This research area is led by Dr Paul Jobsis assisted by two graduate students and one post-doctoral fellow. Significant progress has been made in Year 1, despite the challenges due to COVID-19 and the health precautions that were required.

Goal EA1.1a Obtain permitting and equipment required for tagging sea turtles, fish and conch.

Local and Federal protected species permits have been submitted and are under review. The local permit is scheduled for decision by May 15th, 2021 which will allow the placement of the Acoustic receivers in Brewers Bay, and the transport of green (C. mydas) and hawksbill (E. imbricata) sea turtles to the UVI MacLean Marine Science Center. The Federal permit, NOAA National Marine Fisheries Service permit application # 23259, is under review and should be granted by September of 2021. However, the Jobsis team would like to start acoustically tagging sea turtles early in July of 2021 (Year 2), therefore we have been in discussions with Dr. Kristin Hart to collaborate on her permit, NMFS permit # 20315, starting in July of 2021.

Most of the equipment is in place and purchased by matching funds from the Lana Vento Charitable Trust, the Baird Family Foundation, and the National Save the Sea Turtle fund. The final order using VI-EPSCoR funds was submitted at the end of April 2021 to ensure that the batteries and related equipment will last as long as possible once the array is installed. The installation of the fine-scale positioning system is on schedule to begin on July 1st 2021.

Goal EA1.1b Install Acoustic receivers Hobo temperature loggers and dissolved oxygen loggers in Brewers Bay.

We are in position to begin installation at the start of Year 2, July 2021. The design has been created with the help of students and former employees familiar with acoustic arrays. The new array will focus on movement in the seagrass beds and adjoining reefs and will allow combination with acoustic tracking projects funded by donors mentioned above. The use of donor funding allows us to expand the array to areas known as resting habitat for green sea turtles and fish, as well as foraging areas for hawksbill sea turtles. See figure EA1.1b



Figure EA1.1b

Goal EA1.1c Acoustic tracking student and postdoc engagement for turtle and fish tracking in changing seagrass beds.

Three prospective post-doctoral fellows have been selected for the final interviews in the position search. While a July 1st start date is planned, the completion of the hiring process will need to go smoothly to have the post-doctoral position hired by July 1st. Drs. Nemeth and Jobsis have discussed options if this hire is delayed by a few months due to the difficulty of hiring during the COVID-19 conditions. Installation of the array will continue as planned regardless of where UVI is in the hiring process for this critical position. Most of the analysis will not start until later in 2021 which would allow some leeway in the start date.

Masters student Andrew McGregor, funded by the Baird Family Foundation, is completing his first year and has selected acoustic monitoring in Brewers Bay as his thesis topic. A second student, Taylor Brunson, has been accepted into UVI's Masters of Marine and Environmental Studies program and will be funded by VI-EPSCoR in Year 2. Her focus will be on fine-scale tracking of green sea turtles in Brewers Bay. Masters student Matt Souza has been approached to see if interest in adding tracking conch in the array to his thesis proposal, however a new student may be selected for

this project. These three students will focus on movement ecology and animal tracking in Brewers bay over the next two plus years.

Goal EA1.1d Dropcam and seagrass bed sampling characterization

This goal has no year 1 objectives. It will start in year 2 and run through year 4.

Goal EA1.1e Brewers Bay water quality sampling.

The water sampling in Brewers Bay has been conducted quarterly, with the last sampling date completed on April 8th 2021.

Goal EA1.1f Outreach and Education.

Newspaper and UVI website announcement of the support by the National Save the Sea Turtle Foundation were released March 9th 2021. Information for the VI-EPSCoR blog and newsletter was also submitted in March. On April 1st Dr. Jobsis held an online meeting of the UVI Sea Turtle Club which was attended by six undergraduate students, four graduate students and one incoming graduate student. Dr. Jobsis and UVI Sea Turtle Club president Keedencia Harris plan on a public club meeting in mid May of 2021.

SYNOPSIS: Emerging Areas - Seagrass and Beach

Research Lead: Dr. Gregory Guannel

The major accomplishment is the cataloging of all the major beaches in the USVI. We also attempted to quantify long-term shoreline erosion rates for these beaches but encountered a lack of high-resolution database in all the government databases (NOAA, NASA and USGS).

Another major accomplishment is the acquisition of most surveying and data acquisition equipment. The last major accomplishment is the creation of an agreement with University of South Alabama to share a Ph.D. student for the project, and the recruitment of a student for next year.

Major Accomplishments and Research Findings: Emerging Areas - Seagrass and Beach

The Seagrass and Beach research will focus on quantifying the role of seagrass beds on moderating beach erosion and help beaches rebuild after storms. Because of the impact of the pandemic, field activities have been suspended. As a result a lot of the work has been done from the office.

Activity EA 2.1a and 2.2a: Explore selected sites and acquire equipment and obtain permit(s).

This activity has not been completed because of suspension of field activities. However, we conducted an inventory of beaches in the territory and evaluating methods to estimate their relative stability. This is important to know which beach to focus on to quantify the short and long-term impacts of seagrass beds.

Activity EA 2.1b and 2.2b: Recruit student.

We did not hire an undergraduate student to help with field activities. However, we were able to recruit a Ph.D. student (starting Fall 2021), through a collaboration with Drs. Brett Webb (University of South Alabama, which is part of the Alabama EPSCoR program) and Edwin Cruz-Rivera (UVI). This recruitment is the result of an initial outreach from UVI to USA in order to help ensure that the graduate student employed for this program would have their required training in physical science and engineering, which UVI does not offer at the graduate level. Under this agreement, the student would graduate from USA, but receive a stipend from UVI. Drs. Guannel and Webb negotiated with USA administration to have USA waive tuition costs for the student at USA.

Activity EA2.1d: Wave measurement and analysis.

This activity has not been completed because of suspension of field activities. However, we were able to obtain 20 years of wave hindcast data from University of Puerto Rico and analyze it for the USVI. This task is important in order to gage the relative wave exposure of various sites in the USVI. This is also important for future modeling efforts at the site that will be chosen. In addition, we ordered wave pressure sensors and wave buoys for future deployment.

Activity EA 2.2d: Beach and bathymetric surveys.

This activity has not been completed because of suspension of field activities. However, we ordered and are continuing to order the various equipment required for beach survey and sediment sampling.

SYNOPSIS: Fish Ecology & Herbivory

Research Lead: Dr. Richard Nemeth

The Fish Ecology and Herbivory research will focus on the relationship between habitat composition (turf vs. macro algae) and terrestrial sedimentation rates (low vs. high) on herbivorous species composition, and the effect of these factors on feeding rates, diet and reproduction of the yellowtail parrotfish (*Sparisoma rubripinne*). This project will also examine how oceanographic variability influences timing and frequency of spawning and reproductive output. The Goals of this research will advance our understanding of 1) how natural and anthropogenic stressors on coral reefs change herbivore (i.e. parrotfish) assemblages; 2) how benthic characteristics of impacted reefs affect feeding rates, diet and reproduction (frequency of spawning, fecundity) of parrotfishes; and 3) how oceanographic and environmental variables influence reproductive rates (frequency of spawning and fecundity) of coral reef fish that spawn in aggregations. Goal 1 examines long-term historical data to test if changes in coral reef ecosystems that have low resistance or recovery potential (e.g. shift from low to high macroalgae cover) might affect the composition of fish herbivore communities (shift from *Scarus* to *Sparisoma spp.*). This synthetic analysis is currently underway. A second synthetic analysis will examine the role of sedimentation rates on herbivore fish communities, also using historical long-term data. This will be initiated after the first analysis has been completed. For field-oriented Goals 2 and 3, the preliminary logistics (research permits, IRB approvals, equipment acquisition, graduate student recruitment, and research site plan) have been completed. Fieldwork for this research will begin at the end of academic semester, May 2021. In addition a grant proposal has been submitted to Puerto Rico Sea Grant College program to leverage the VI-EPSCoR funded research.

Major Accomplishments and Research Findings: Fish Ecology & Herbivory

Research technician Elizabeth Kadison was hired to support research objectives of the Fish Ecology - Parrotfish herbivory project. Graduate student Jenna Cheramie was recruited in October 2020 to conduct research on the Parrotfish herbivory project. She has completed her thesis proposal and is on target for initiating research in May 2021. Ms. Kadison is supervising Ms. Cheramie on assessing in-house acoustic receivers for functionality. Ms. Keedencia Harris was recruited to support a variety of research projects, including the parrotfish herbivory research. She will be receiving her PADI SCUBA certification in May 2021, allowing her to participate in underwater activities. Reconnaissance of Fish Bay watershed was conducted with David Hensley (terrestrial component team lead) in late February 2021. We identified several suitable locations for stream gauge sensors. Preliminary surveys of the Reef Bay study site by Nemeth and Kadison were conducted in late March 2021 to confirm presence of two *Sparisoma rubripinne* (target parrotfish species) spawning aggregation sites. Both sites were confirmed with actively spawning parrotfish. Acoustic transmitters have been ordered and expected delivery will be mid-May 2021. IRB permit (#1602189-1) was approved for conducting acoustic telemetry project on parrotfish from May 8, 2020 to May 7, 2023. A research permit from the National Park Service is in final stages of completion. The permit application included a draft acoustic telemetry array for the Reef Bay study site (Figure 1). A research letter of intent was submitted to the University of Puerto Rico Sea Grant College Program for a proposal to leverage the VI-EPSCoR funded project. The pre-proposal was recommended for full proposal submission (due 14 May, 2021) and will extend the scope of the current project and provide funding to recruit another graduate student.

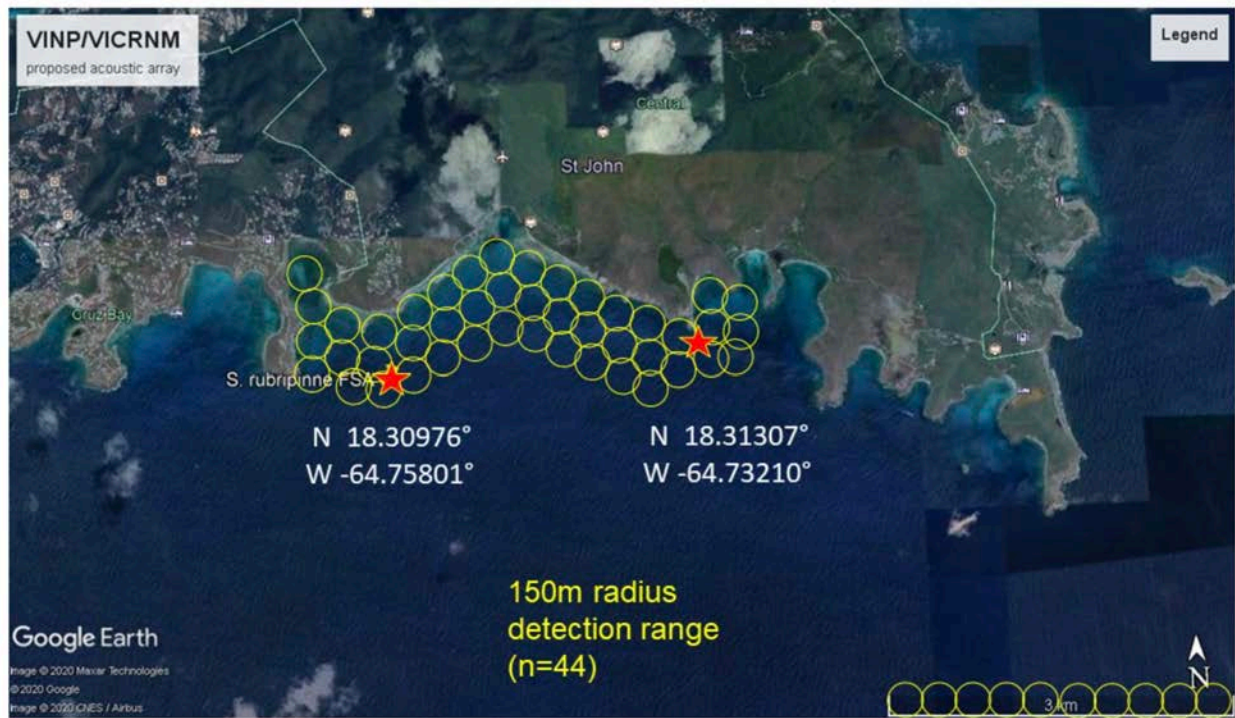


Figure 1. *Proposed acoustic array in Fish Bay, Reef Bay, Europa Bay, St. John for tracking fish and spawning migrations of the yellowtail parrotfish (Sparisoma rubripinne). Red stars indicate the locations of two parrotfish spawning sites and yellow circles indicate an estimated 150m radius detection range for acoustic receivers.*

SYNOPSIS: Oceanography

Research Lead: Dr. Sennai Habtes

Overall, in year 1 most goals have been met, or significant progress have been made towards them. During this reporting period one grant for a large-scale NSF CoPE (Large-Scale CoPe: Connecting Communities & Co-Innovating Nature-Based Solutions to Reduce Storm Exposure and Social Vulnerabilities” NSF ID# 2104063) was submitted with UVI as a collaborating institution with Dr. Habtes as the lead researcher, and is still under review. Also a supplement for an existing NSF GOLD-funded Sparks for Change (“GEO Opportunities for Leadership in Diversity” NSF ID# 1645453) project was granted.

A major focus of the current year has been to purchase the necessary equipment for research to be accomplished in years 2-5. Specifically, we purchased Matlab Software to aid in the processing and final outputs of oceanographic data and a specialized Dell Workstation capable of running oceanographic models. Instrumentation purchased includes the acquisition of four Nortek Signature 1000s with the capability to measure wave height and direction, current velocity, and backscatter. These instruments will give us the opportunity to measure the water column, and to study a part of the turbulence spectrum that has not been accessible before and we will now have the capability to collect high-resolution measurements of biomass in the water column with the biological echosounder. Additionally, we have purchased a Sea-Bird Electronics HyroCAT-EP that measures conductivity, temperature, depth, oxygen, pH, turbidity, and chlorophyll that will enable us to collect long-term data of these parameters at the reef bay spawning sites. General equipment was also purchased this year to continue the growth of our capabilities and to continue to be able to maintain the fleet of instrumentation that includes HOBO temperature logger shuttle, external hard drive, adapters, and a YSI water quality monitoring EXO sonde. The YSI sonde is used by many UVI students and employees to measure and collect water quality parameters in our near-shore environment. Two Sea-Bird Electronics ECO-PARs measuring the ambient light field in the ocean in the range of photosynthetically active radiation (400-700 nm) were also acquired. The Ocean Lab has developed an ECO-PAR platform for data quality control and the instructions for preparing, deploying, and acquiring data from the sensor. It has involved developing a software plan using a third-party command window and developing the sequence of commands needed for communicating with the sensors for programming user settings, deploying, and offloading of the data. We also developed a metadata system for each deployment and file naming convention as well as utilizing UVI's Dropbox for data storage and backup.

To prepare for R2R research a number of existing research equipment required maintenance and calibration. The Sea-Bird Electronics (SBE) 25plus-1107 CTD, was sent in for service and maintenance completed in April 2021 and is scheduled for return to UVI in May. The other CTD package (SBE 25-0407) will receive the same calibration, maintenance, and service. Once finalized we will have both CTD packages available to all researchers for use in upcoming R2R research. The Ocean Lab is responsible for maintaining and calibrating all of the Onset HOBO temperature loggers. The calibration is not a true calibration of the sensor but a calibration check that helps to ensure the quality and stability of the acquired data. This past year we performed five calibration checks on over 100 HOBO loggers. We have also developed a data management and assurance plan that has been documented by an SOP and taught to multiple sets of incoming graduate students to aid in the final processing and QA/QC of the collected data.

The Ocean Lab has spent the last year developing a set of manuals and standard operating protocols (SOP) for all oceanographic instrumentation and sensors in our fleet. We are standardizing the formats of these SOPs and developing a step-by-step approach making it very user friendly for anyone to use the oceanographic equipment. We have finalized these for the Nortek ADCPs, Onset HOBO loggers, YSI EXO sondes, and the Sea-Bird CTDs (with minimal revisions still ongoing). All of these SOPs are living documents and are always being updated with new information, updated protocols, technician tips, and more user-friendly step-by-step dialog with the goal to be able to pick up the SOP and be able to use the oceanographic instrumentation without fully having to read a full manufacturers manual. We have also developed a Metadata Sheet for use in equipment deployment by R2R researchers to ensure higher data accuracy and assist in data processing, QA/QC, and archiving.

Other accomplishments included the completion of a primitive equation numerical modeling system for the US Caribbean coastal ocean based on the ROMS AGRIF (Regional Ocean Modeling System with Adaptive Grid Refinement in Fortran) architecture. This system, named the US Caribbean Coastal Ocean Model (USCCOM), simulates the ocean properties by numerically solving the geophysical Navier-Stokes equations in an orthogonal curvilinear grid with terrain-following vertical coordinates where the top-most grid-face is the sea surface. The USCCOM is composed of a parent grid of 2 km resolution that holds 2 separate nested grids (300m resolution) in a 1-way coupling system covering St. Thomas and St. Croix. The parent grid uses climatological

data on the ocean properties from the Daily Global Physical Bulletin at 1/12° (PSY4) and simulates the ocean properties in the US Caribbean ocean.

Preliminary results from this system have shown a strong correlation of the simulated sea-surface height with tidal gauge measurements on the coast of St. Croix, St. Thomas and Puerto Rico. Analysis of the simulated ocean circulation from USCCOM has revealed many interesting observations including seasonal variability in current direction through the Virgin Islands Basin/Trough, strong upwelling in the coastal waters of the islands, internal waves below a shallow mixed-layer, and high dissipation of eddy kinetic energy in deep turbulent wakes formed at the edges of the islands. Subsequently, we intend to use the outputs from the USCCOM to have a realistic understanding of the impact of the local circulation on the dynamics of different larval species and the dispersion of sediments, and upon further analysis develop these results into a manuscript. Additionally the outputs from this model will be used in future years to model connectivity pathways as part of the Fish Ecology and Coral Reef Resilience R2R research.

Our manuscript on the comparison of the performance of different mesoscale models in the US Caribbean ocean is currently under review at the Journal of Operational Oceanography. In addition, we have developed the infrastructure for the storage and output from the USCCOM simulations and an interim system for sharing the data with partners and collaborators via an ftp site hosted on our AZURE cloud computing server. At present current velocity data from the USCCOM simulations have been shared with R2R collaborators Dr. Daniel Holstein at LSU and regional partners Dr. Iliana Chollett at Marine Analytics and Management Tools as part of research funded by the Lenfest Ocean Program that is working with the Caribbean Fisheries Management Council.

Personnel within the oceanography research area were co-authors on two published papers (Marine Ecology Progress Series & Aquatic Botany), and authors on one submitted paper under review (Journal of Operational Oceanography). We completed three presentations on our research at conferences, workshops, and online meetings. These included: a presentation and panel discussion at the 2020 SACNAS, National Diversity in STEM Conference; a panel discussion for the GEO REU Workshop Series: Elements of an REU; and a panel discussion for #BlackinMarineScienceWeek.

Major Accomplishments and Research Findings: Oceanography

The Oceanography research effort is the hub that links the marine science-related research efforts within the R2R project, since variability in oceanographic conditions can be predictors of the drivers influencing coral reef ecosystem resilience. This research team will focus on understanding the oceanographic conditions that drive connectivity patterns related to the increased biodiversity at more resilient coral reefs, and in understanding the influence of oceanographic, environmental, and terrestrial inputs on the reproductive rates of a ubiquitous reef fish, the yellowtail parrotfish (*Sparisoma rubripinne*), between algal turf vs. macroalgal dominated nearshore reef sites. The Coastal Oceanography emerging research area is led by Dr. Sennai Habtes, and is supported by investigators Dr. Paul Jobsis, Director CMES, and Dr. Doug Wilson, courtesy professor CMES. This research area is staffed by Oceanography technician, Vanessa McKague; Ocean Circulation Postdoctoral Researcher, Dr. Sonaljit Mukherjee, and data technician Andy Breton.

During the 2020 fiscal year the members of the ocean lab has continued to make progress on our priorities, which include building the coastal oceanography research team, strengthen research partnerships, collaborate with UVI and VI-EPSCoR multidisciplinary teams and develop the oceanographic research capacity of the Territory. During the current reporting year the oceanography research unit has begun the planning and initialization of research for the oceanography component of the VI EPSCoR R2R project and made progress on our priorities. Unfortunately, UVI is still dealing with the substantial loss of infrastructure from hurricanes Irma and Maria in 2017, and Dr. Habtes the research lead for this component has decided to take a leave of absence from UVI to serve as the Bureau Chief of Fisheries for the Division of Fish and Wildlife at the Virgin Islands Department of Planning and Natural Resources. In spite of these issues the oceanography research unit has focused much of this reporting period planning and preparing to complete the research efforts under the R2R project. Under OC1.1A and OC2.2A, the research team has completed an audit of existing instrumentation and determined the necessary equipment needs moving forward. This has included sending one SBE 25 plus, and one Nortek Aquadopp profiler ADCP back to the manufacturer for calibration and repair, as well as the purchase of four Nortek Signature 1000 ADCP's for deployment at the reef bay and coral restoration sites, and one YSI water quality sonde for the Environmental Analysis Laboratory, two Seabird ECO-PAR'S, a Seabird HydroCAT-EP, a Dell Workstation computer. In addition we have made arrangements with Seabird Electronics to return a SBE 25 for calibration and repair upon receipt of the SBE 25 plus. Towards progress on OC1.1B, Dr. Habtes has

been appointed to serve as the Chair of the Ecosystems Based Fisheries Management (EBFM) Technical Advisory Panel for the Caribbean Fisheries Management Council. Dr. Habtes is collaborating with Juan Cruz-Motta, Tarsilla Seara, and Stacey Williams Lenfest-funded project guiding the development of a Fishery Ecosystem plan for the US Caribbean. As part of this research, we have compiled a database of all variables that would contribute towards EBFM in the US Caribbean. The oceanographic variables from this database will be used in conjunction with the timeseries data from UVI ADCP's, temperature loggers, and CTD's. We currently have a broad list of the available data, and are currently summarizing the spatial and temporal limits of the available data in order to identify which variables are suitable for further analysis via statistical modeling combining the parrotfish fecundity and oceanographic data. To prepare the data from UVI instrumentation for R2R research we have been finalizing manuals, standard operating protocols, the processing and quality control of all the data that has been previously collected and developed the infrastructure on the Microsoft AZURE cloud computing server for storage and archiving of this data. We are standardizing the formats of these SOPs and developing a step-by-step approach making it very user friendly for anyone to use the oceanographic equipment. We have finalized these for the Nortek ADCPs, Onset HOBO loggers, YSI EXO sondes, and the Sea-Bird CTDs (with minimal revisions still ongoing).

Under OC1.2 and OC1.3 Dr. Nemeth (R2R Fish Ecology) has conducted site surveys of both sites in Reef Bay. He and Dr. Habtes have met to discuss site characterization, which has informed sampling and deployment plans currently under development by oceanographic technician Vanessa Wright, as well as to develop succession plan while Dr. Habtes is on a leave of absence. This has included analysis of what research objectives in the strategic plan can be continued and which may have to be redesigned. Pelagic larval duration tables for *Sparisoma* spp. have been developed using the research from former oceanography student Kristen Ewen's Master's thesis completed under *Mare Nostrum* research.

Under OC2.1 We developed a primitive equation numerical modeling system for the US Caribbean coastal ocean based on the ROMS AGRIF (Regional Ocean Modeling System with Adaptive Grid Refinement in Fortran) architecture during *Mare Nostrum* Research. The US Caribbean Coastal Ocean Model (USCCOM), simulates the ocean properties by numerically solving the geophysical Navier-Stokes equations in an orthogonal curvilinear grid with terrain-following vertical coordinates where the top-most grid-face is the sea surface. The nested grids of the USCCOM use the model outputs from the parent grid and simulate the ocean properties around St. Thomas and St. Croix

at a higher resolution of 330 m, which is currently the finest resolution compared to any other operational system for the US Caribbean region. Preliminary results from this system have shown a strong correlation of the simulated sea-surface height with tidal gauge measurements on the coast of St. Croix, St. Thomas and Puerto Rico. Analysis of the simulated ocean circulation from USCCOM has revealed many interesting observations including a seasonal variability in the current direction through the passage between St. Thomas and St. Croix, strong upwelling in the coastal waters of the islands, internal waves below a shallow mixed-layer, and high dissipation of eddy kinetic energy in deep turbulent wakes formed at the edges of the islands.

Subsequently, we intend to use the outputs from the USCCOM to have a realistic understanding of the impact of the local circulation on the dynamics of different larval species and the dispersion of sediments. These results are currently being developed into a manuscript by oceanographic postdoctoral researcher Dr. Sonaljit Mukherjee and Dr. Habtes.

Another manuscript on the comparison of the performance of different mesoscale models in the US Caribbean ocean is currently under review at the Journal of Operational Oceanography. In addition, we have developed the infrastructure for the storage and output from the USCCOM simulations and an interim system for sharing the data with partners and collaborators via an ftp site hosted on our AZURE cloud computing server. At present current velocity data from the USCCOM simulations have been shared with R2R collaborators Dr. Daniel Holstein at LSU and regional partners Dr. Iliana Chollett at Marine Analytics and Management Tools as part of the Lenfest funded project.

To meet strategic goals for OC2.2 a working group composed of VI EPSCoR staff and volunteers from vessel management programs within NOAA and UNOLS has been developed by Doug Wilson, with plans to meet annually. In addition, we have outlined operational costs and revenue analysis for the research vessel and are currently pricing out the necessary costs for equipment and vessel upgrades necessary to have an operational coastal ocean class research vessel. Due to Dr. Habtes's leave of absence the VI EPSCoR program and University administration will need to determine the feasibility of continuing the development of the oceanography vessel program and are waiting on a response from UVI's administration regarding administrative requirements for operating the vessel for research from other institutions, as well as a document outlining the management and decision support system for vessel operations from VI EPSCoR administration. Drs. Habtes, Wilson, and Jobsis have identified a number of

funding opportunities to submit to during the upcoming year and are working collaboratively on submissions.

Under OC3 we have supplied submissions for the VI EPSCoR website and newsletter, and recruitment for undergraduate and graduate students have been postponed due to Dr. Habtes' leave of absence. However, it has been recommended that the funding for these students be re-allocated to Drs. Nemeth or Smith, who are collaborating and likely incorporating the research objectives of the oceanography research area under the fish ecology and coral reef resilience research areas, respectively.

SYNOPSIS: Coral Disease & Restoration

Research Lead: Dr. Marilyn Brandt

The Coral Disease Research focus will investigate the relationship between coral disease incidence and coral community composition and local water quality. It will also experimentally test coral disease transmission among experimental species compositions and under different water quality conditions. Results from these experiments will be integrated with a hydrodynamic model to test how disease spread is influenced by reef composition and spatial distribution. The overall goal of the Coral Disease Research focus is to predict the spread and impact of multi-species coral disease. A Marine Disease Specialist was hired to support research activities. Existing datasets on disease distribution were summarized and have been either submitted and accepted for publication (2 manuscripts) or will be submitted in the coming months (2 manuscripts). Further experiments are planned for the summer and fall of 2021 and work on integrating the hydrodynamic modeling results with disease distribution is ongoing. A grant proposal was submitted to the NSF Ecology and Evolution of Infectious Disease program.

The Coral Restoration focus will measure how the success of restoration is influenced by local water quality conditions and multi-species interactions. Experiments will test how outplanted coral growth and survival are influenced by positive interactions from other coral species and reef taxa. Restoration activities will also take place across a range of water quality and lab-based experiments will also be used to determine the effect of local water quality parameters, such as nutrients and sediments, on outplanted coral growth and survival. The overall goal of the Coral Restoration Research focus is to identify key factors that increase the success of coral restoration activities. A disease transmission experiment determined that direct outplanting, versus nursery rearing of coral outplants, may cause corals to be more vulnerable to disease. A multi-species outplanting pilot experiment was implemented and is currently being monitored. Six graduate student interns participated in coral restoration research and activities. An education program was established with a local business, the Lovango Resort and Beach Club, and outreach activities included presentations and the creation of a permanent information sign. A proposal was submitted to the National Park Service to support coral restoration in the Virgin Islands National Park and a proposal was submitted to the DARPA Reefense program.

Major Accomplishments and Research Findings Coral Disease & Restoration

Major personnel activities under Coral Disease and Restoration included the hiring of a Marine Disease Specialist to assist with the Coral Disease and Restoration theme in the fall of 2020. Ms. Sonora Meiling, a 2020 graduate of the UVI Master of Marine and Environmental Science (MMES) program, was hired as the Marine Disease Specialist.

Goal MD1: Determine how species biodiversity affects the spread and impact of coral disease

Datasets that were identified and compiled included the long-term (since 2002) coral reef monitoring data from permanent stations from around the U.S. Virgin Islands from the Territorial Coral Reef Monitoring Program (TCRMP). This dataset was used to analyze trends and patterns in disease prevalence and impact in the first 18 months following the emergence of stony coral tissue loss disease (SCTLD) in the territory. Species susceptibilities and disease spread were documented and summarized in a manuscript which will be submitted to the special issue of *Frontiers in Marine Science* focused on SCTLD (deadline May 15).

- Manuscript citation: Brandt ME, Ennis RS, Meiling S, Townsend J, Cobleigh K, Glahn A, Quetel J, Brandtneris V, Henderson LM, Smith TB. In prep. The Emergence and Impact of Stony Coral Tissue Loss Disease (SCTLD) in the United States Virgin Islands. In preparation for *Frontiers in Marine Science*

The National Coral Reef Monitoring Program (NCRMP) dataset, which includes data collected on coral species composition and disease prevalence from randomized stations around the territory in 2017 and 2019 provided the basis for a capstone project completed in the spring of 2020 by the 2019 Master of Marine and Environmental Science (MMES) program cohort. The cohort repeated NCRMP surveys at a subset of sites surrounding St. Thomas in 2020 to evaluate the prevalence and impact of SCTLD on coral diversity and community composition. With advising from M. Brandt and T. Smith, three students from the cohort, Sophia Costa, Stephanie Hibberts, and Danielle Olive took the lead on continuing to analyze the species composition data and impact of SCTLD. They completed the analysis and submitted the results to the special issue of *Frontiers in Marine Science*. They received positive reviews back in April 2021 and are currently revising the manuscript.

- Manuscript citation: Costa SV, Hibberts SJ, Olive DA, Budd KA, Long AE, Meiling SS, Miller MB, Vaughn KM, Carrión CI, Cohen MB, Savage AE, Souza MF, Buckley L, Wilson Grimes K, Platenberg R, Smith TB, Blondeau J, Brandt ME. Revising. Diversity and Disease: The effects of coral diversity on prevalence and impacts of stony coral tissue loss disease in Saint Thomas, U.S. Virgin Islands. Submitted to Frontiers in Marine Science

Data from a disease transmission experiment that tested the susceptibility among multiple coral species to SCTLD that was performed in the spring of 2019 was analyzed and a manuscript generated and submitted to the special issue of Frontiers in Marine Science. The manuscript was accepted and is currently in press. The experiment was initially funded by a RAPID grant from the NSF Biological Oceanography program. Support from VI-ESPCoR in year 1 of the Ridge to Reef program supported the Marine Disease Specialist, S. Meiling, to complete the analysis of the experiment and develop the manuscript.

- Manuscript citation: Meiling SS, Muller EM, Lasseigne D, Rossin A, Veglia AJ, MacKnight N, Dimos B, Huntley N, Correa AMS, Smith TB, Holstein DM, Mydlarz LD, Apprill A, Brandt ME (in press) Variable species responses to experimental stony coral tissue loss disease (SCTLD) exposure. Frontiers in Marine Science 8:670829.

Goal MD2: Determine how local stressors (e.g., nutrients, turbidity) and global stressors (e.g., temperature stress) drive temporal and spatial distributions of disease.

Previously collected data for S. Meiling's M.S. thesis on SCTLD-associated lesion progression rates were published in the peer-reviewed journal Frontiers in Marine Science. These data described lesion progression rates that were extracted from 3D photogrammetry from multiple species of corals and their dynamics through the thermal stress event of 2019.

- Manuscript citation: Meiling S, Smith TB, Muller E, Brandt ME. 2020. 3D photogrammetry reveals dynamics of stony coral tissue loss disease (SCTLD) lesion progression across a thermal stress event. Frontiers in Marine Science 7: Article597643).

Goal MD3: Predict the spread and impact of multi-species coral disease.

Data collected in Goals 1-2 will be used as a basis for developing disease spread models.

Goal MD4: Share Disease Research with Stakeholders through participation in outreach and education activities.

Brandt and her laboratory supervised and mentored five coral restoration interns over the 2020-2021 academic year: 3 interns in the fall of 2020 (D. Mele, K. Vaughn, S. Hibberts) and three interns in the spring semester of 2021 (K. Budd, C. Carrion, M. Souza). Interns in the fall were limited by restrictions from the COVID-19 pandemic, but were able to learn microfragmenting techniques and seawater table maintenance in support of coral restoration. At the end of the fall semester, they were able to participate in the set up and outplanting for a multi-species diversity experiment in support of Goal MR2 (see below). Intern D. Mele worked with Brandt and other coral restoration personnel to develop signage that will be placed on Lovango Cay, in collaboration with the Lovango Beach Club and Resort. The signage will provide information on the need for coral restoration and highlight methods of the coral restoration process. The signage was created with design input and artistry from Elisa Bryan and Jarvon Stout.

Goal MR1: Expand capacity for restoration ecology research in the US Virgin Islands.

An advertisement for a Restoration Ecologist faculty position was posted at the end of March 2021 and will close on April 30. A search committee has been formed consisting of EPSCoR leadership and faculty as well as faculty from the UVI College of Science and Mathematics.

Goal MR2: Determine how diversity affects success of coral outplanting.

A pilot study of the multi-species outplanting experiment was implemented at Lovango Cay in December of 2020. Twenty plots were established, and within each plot three corals were outplanted/transplanted according to one of four treatments: Treatment 1) three *A. cervicornis* outplants, 2) one *A. cervicornis* outplant and two *O. annularis* transplants, 3) one *A. cervicornis* outplant and two *Porites astreoides* transplants, and 4) one *A. cervicornis* outplant, one *O. annularis* outplant, and one *P. astreoides* outplant. These plots have been monitoring approximately monthly for the health, growth and survival of the outplanted and transplanted corals. The three coral restoration graduate interns from spring of 2021 have been working to analyze the photo plots.

An opportunity to collaborate with The Nature Conservancy (TNC) occurred in December 2020. Marine Disease Specialist S. Meiling along with MMES graduate student Lindsay Dade coordinated with TNC to test disease transmission among small coral fragments (that represented the size of outplanted corals), freshly microfragmented corals, and recently settled juvenile corals. The experiment took place at TNC's new coral restoration and research center on St. Croix and lasted 8 days. Disease transmission to recently settled juvenile corals was unclear due to the logistical difficulties of monitoring the small corals during the experiment. However, it was found that freshly microfragmented corals were more susceptible to disease than small coral fragments, suggesting that direct outplanting techniques may be more vulnerable to disease. These results were presented to the Virgin Islands Coral Disease Advisory Committee in March 2021 and are currently being prepared for publication.

Goal MR3: Determine how gradients in water quality affect success of coral outplanting.

Water quality sampling began at nine sites, including selected outplanting locations in March-April 2021. Results include fecal coliform counts and turbidity measurements that were analyzed by the UVI Environmental Analysis Laboratory. Samples were sent out to measure nutrient levels. Continued sampling will occur at each of these locations for three consecutive months in each of the dry and wet seasons.

Goal MR4: Share Restoration Research with Stakeholders through participation in outreach and education activities.

In the fall of 2021, an MOU was signed with the Lovango Resort and Beach Club to develop an education program centered on coral restoration. Over the fall semester, coral restoration graduate intern D. Mele worked with Brandt and other coral restoration personnel to develop signage that will be placed on Lovango Cay. The signage will provide information on the need for coral restoration and highlight methods of the coral restoration process. The signage was created with design input and artistry from Elisa Bryan and Jarvon Stout. The final design of the signage was approved in April 2021 and will be sent for printing in May 2021.

In the spring semester of 2021, coral restoration graduate interns Kayla Budd and Kaya Carrion developed a coral restoration information presentation to be given to Lovango Cay visitors. They presented in March 2021 an initial version. The presentation was

then finalized in April 2021 and will be given again in May 2021. It is expected that this presentation will be given monthly at Lovango Cay by future coral restoration interns.

SYNOPSIS: Coral Reef Resilience

Research Lead: Dr. Tyler Smith

The Coral Reef Resilience research is investigating drivers of coral reef resilience to major disturbances in the US Virgin Islands. Infrastructure investments of VI-EPSCoR have allowed the collection of long-term environmental data sets centered on understanding the ecology of coral reefs. These include detailed empirical and modeled biological and oceanographic data sets at 42 coral reefs across a major thermal stress and coral bleaching event in October 2005 to a double strike of major hurricanes in September 2017. Performance of coral reefs during the recovery period (2007-2017) will be used to determine the most important internal biological and external physical drivers related to recovery, the restoration of coral cover and diversity. This research area has engaged 13 masters students in developing reef resilience metrics and herbivory metrics. This research area will involve over 20 researchers spread across academic institutions, local and federal agencies, and NGO's. Insights will lead to new understanding of reef ecology and will have direct applications to management by identifying the factors that will provide the best opportunity for the restoration of reef resilience.

Major Accomplishments and Research Findings

Coral Reef Resilience

Major accomplishments of the Coral Reef Resilience research theme involved initiation of the multi-disciplinary study of coral reef resilience in the US Virgin Islands (USVI). Under the initial strategic plan and proposed timeline for this study Year 1 was dedicated to assembling the data sets needed to characterize the external (Objective CR1.1) and internal (Objective CR1.2) drivers of coral reef resilience, leading to a database of metrics compiled in Year 2, and analyses in Year 2 and 3 (Objectives CR1.3-5).

Objective CR1.1: Create a comprehensive database of external drivers (biophysical regimes) at 42 long-term research sites, with emphasis on describing stressors, disturbance, and other processes that have a potential influence on reef resilience at each location.

Progress has been made in external drivers database production in key areas of temperature, benthic orbital velocity, and water quality, but delayed in the area of current regimes. A quality controlled benthic temperature database from most of the resilience study sites has been developed and includes all data covering the study period (initiation to 2019). Data from Pete Edmunds' Lameshur Bay, St. John study sites need to be incorporated. Benthic orbital velocity data has been compiled for most study sites. Needs to be expanded in time to cover the project period as more modeling runs are completed by CariCOOS (Dr. Miguel Canal-Silander, Dr. Sonaljit Mukherjee) and validated at nearshore sites to understand issues with land masking in the model. Remotely sensed water quality products were developed for validation sites and developed into ocean color metrics for the USVI as part of a NASA EPSCoR project (PI Dr. Brandt, Dr. Adem Ali - College of Charleston, Dr. Joseph Ortiz - Kent State University). An additional NASA EPSCoR proposal was submitted to refine these metrics to the next generation of space-based sensors, but we will concentrate on in-hand metrics for this product. The characterization of water currents at sites has been delayed awaiting finalization of the current modeling (Dr. Habtes is taking a 1-year leave of absence, Dr. Mukherjee is finalizing the model). These ocean current products are still expected to be forthcoming in Year 2.

Objective CR1.2: Create a comprehensive database of the internal drivers (biological characteristics and processes) at 42 long-term research sites, with an emphasis on factors that have a potential influence on coral reef resilience.

Progress has been made in internal drivers database production in key areas of coral diversity, marine disease, nuisance species, other invertebrates, fish diversity, herbivory, rugosity, coral health, and coral interactions, but delayed in connectivity network development. Databases of internal drivers where progress has been made are all in hand and are being quality controlled. The 2020 Masters of Marine and Environmental Science cohort used the development of herbivory metrics (biomass, grazing pressure, grazeable substrate) as part of their second semester capstone project to investigate the role of herbivory in reef resilience. This project laid the foundation for developing the herbivory metrics and resilience metrics to be used in R2R resilience study and the students are writing a draft manuscript to be submitted for peer-reviewed publication. This has resulted in student engagement in the R2R project and jump-started the process of metric development for the resilience study. Delays in the development of the regional ocean current model, as mentioned in the description of progress for external drivers, has delayed initiation of the connectivity modeling.

SYNOPSIS: Education and Workforce Development

Research Lead: Dr. Lawanda Cummings

The Ridge to Reef Education and Workforce Development component has pursued three primary goals over the past year. Our work within Education and Workforce Development (EWD) focuses on promoting STEM learning in both formal and informal spaces in the USVI. This work is critical in the development of an empowered STEM workforce for the future. Formal learning focuses on 1) Teacher Professional Development, 2) Mentoring and Research Infrastructure, and 3) Undergraduate Enrichment. Informal Learning focuses on 1) Enrichment of science clubs/programs and 2) Community outreach events.

On the formal learning front, one goal has been to implement an effective STEM Education research program aligned to R2R resilience themes at the University, integrating place-based science at the community, k12, undergraduate levels. The second major goal has been to develop teacher-led, self-sustaining professional development through Professional Learning Communities (PLCs) for STEM teaching in the Territory's secondary schools. Our third goal was to increase the recruitment, retention and persistence of URM undergraduates in STEM and resilience-related majors, minors, and certificate programs. The EWD component was successful in completing all of the Year 1 strategic actions through the activities of the VI Institute for STEM Education Research and Practice (VI-ISERP). Our STEM Education research program has continued to develop with 6 projects by VI-ISERP- supported faculty and collaborators across the University. Four presentations have been made at national and international meetings during the reporting period. One manuscript has been published in peer-reviewed publications and two manuscripts are in preparation. Two proposals were submitted for external funding and one additional proposal is in process for submission.

Within the STEM Education research program, we now have five UVI faculty who are conducting research or education programming. Projects include collaboration with other UVI faculty not supported by VI-EPSCoR as well as projects supported by other external funding agencies. These research projects continue to grow and have generated wider interest across the University in STEM Education research and Informal Learning. Dr. Chris Plyley, in mathematics education, continues collaborative research focused on language and Mathematics with Dr. Hernandez, noted linguist. Drs. Nadia Monroe Mills and Verleen McSween have continued their work developing the UVI Growth Model for student success with other College of Science and Mathematics

(CSM) faculty at UVI. Dr. Monroe Mills has a published blog entitled “How STEM faculty and k-12 teachers in the US Virgin Islands found support during a pandemic” on the VI-ISERP response to teacher support during COVID-19 within the Math Values Blog for Mathematical Association of America.

Dr. Monroe Mills has received NSF funding (\$309,763; Award number:2025228) for a proposal for her work with Peer-Led Team Learning (PLTL) student support structures using the UVI Growth Model. Drs. Nadia Monroe Mills and Chris Plyley completed a presentation at the Hawaii EPSCoR: Tropical Island Water Futures: Water for People and Ecosystems in the Face of Change Conference, Virtual Conference. Drs. Plyley and Guannel also presented with students (A. Freeman and B. Good) at the 2021 AERA conference.

Drs. Lawanda Cummings, Chris Plyley and Diana Bowen submitted a collaborative NSF I-TEST proposal entitled Collaborative Research: Scaling, Expanding, and Iterating Innovations (SEI): BUILDERS without Borders (BwB) with Dr. Mohammad Qazi at Tuskegee University and Dr. Martha Escobar at Oakland University. Drs. Lawanda Cummings and Verleen McSween submitted an informal learning proposal to NSF AISL entitled Science to Families (SCI2FAM) Science Learning Ecosystem: Water Both Land and Sea in the Fall of 2020 in partnership with informal learning community specialist Jarvon Stout. Dr. Cummings, Resa Berkeley (Data Analyst), and Jarvon Stout (IL) presented a poster at the SE Eco Conference entitled Building Bridges of Knowing: Using Culturally Relevant Pedagogy Theory to build Community STEM Literacy. Dr. Cummings and Resa Berkeley (Data Analyst) have an accepted workshop discussing Culturally Relevant Pedagogy in Community Outreach at the CREA 2021 conference. In partnership with Santa Fe College and the Florida-Caribbean Louis Stokes Regional Center of Excellence (FL-C LSRCE), Dr. Cummings has a paper accepted on customized interventions at the CREA 2021 conference also.

As Director of VI-ISERP/FL-C LSRCE, Dr. Lawanda Cummings has facilitated five faculty-development sessions on Growth Mindset, Cultural Inclusion and Intervention strategies with Drs. Jhenai Chandler of Santa Fe College and Jesse Ford of The University of North Carolina at Greensboro. Drs. Cummings and McKayle presented a paper at the Institute for the Study and Promotion of Race and Culture Diversity Challenge Conference with Drs. Chandler (Santa Fe College), Waschull (Santa Fe College), Wilson-Howard (Bethune-Cookman University), and Brooks (Tallahassee Community College). Drs. Cummings, McSween, and McKayle also presented a paper

at the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) with Drs. Chandler, Waschull, and Lee (Santa Fe College).

Drs. Verleen McSween and Cummings are the component leads for Mentoring and Research Infrastructure. Dr. McSween has recruited UVI faculty for mentor training through the Center for the Improvement of Mentored Experiences in Research (CIMER) at the University of Wisconsin in Madison to increase the institutional capacity for effective student support. Dr. McSween has presented at the 2021 Massachusetts Project Kaleidoscope (PKAL) Network Winter Meeting a paper entitled Effective Implementation of Informal STEM Learning Practices in the Virtual Classroom. Dr. McSween has an accepted paper for the Iorida-Caribbean Louis Stokes Regional Center of Excellence: Developing and Modeling Mindsets for STEM Virtual Conference 2021, in collaboration with Dr. Roger of UVI. Lastly, to improve research infrastructure, we will be hosting the NSF funded Professional development for Emerging Education Researchers: PEER Field Schools at UVI to stimulate and encourage research development at the graduate and faculty levels in partnership with Dr. Franklin of the Rochester Institute of Technology.

VI-ISERP supports in-service teachers as practitioner-researchers through the development of culturally relevant curricula, mastery in content areas, and improved use of educational technology. Our Teacher Professional Development program has long-standing collaborations with the Virgin Island Department of Education and Board of Education with over 4000 hours of professional development to local teachers to date. We are currently hosting weekly “Teacher Talk Fridays” to help local teachers navigate the stresses and professional demands from the COVID-19 pandemic. The VI-ISERP team is actively planning for our 2021 virtual **STEM Institute** for the summer. Drs. Nadia Monroe Mills and Christopher Plyley, co-directors of the institute, will train and support a group of teachers in effective STEM teaching strategies, reflective practice and research through Professional Learning Communities (PLCs), and the development of project-based lessons that localize STEM learning to the USVI. At the core of the PLCs are Mentor Teachers who participate in training their peers in inquiry and project-based learning practices, infused with VI-EPSCoR research, aligned with Next Generation Science Standards (NGSS) and based on Common Core State Standards for Mathematics (CCSM). The Summer Institute’s co-directors have planned a virtual institute for in-service teachers in June 2021 leveraging the expertise of Dr. Diana Bowen (math instruction specialist and Growth Mindset trainer) and researchers from R2R. Additionally, the STEM Institute has developed curricula this year for a certificate program for STEM educators as well as training modules on teaching best practices for

virtual, hybrid, and in-class formats in preparation for changes in how we learn due to the pandemic.

VI-ISERP now has 10 Mentor Teachers successfully implementing locally relevant problem-based learning projects in VI virtual classrooms. These teachers are continuing to take on a leadership role in the VI-ISERP academic year (AY) training and activities as well as doing presentations on their virtual classroom strategies and techniques. In response to COVID-19 needs, teacher programming and support has focused on education technology, virtual teaching strategies, and psychological support for teachers. Through support from the Community Foundation of the Virgin Islands (CFVI) and the Jones Foundation, mobile Wifi was provided to teachers in need. Teachers were also loaned VI-ISERP laptops and ipad mini to facilitate continued instruction for local students.

Major Accomplishments and Research Findings: Education and Workforce Development

Education and Workforce Development focuses on promoting STEM learning in both formal and informal spaces in the USVI. This work is critical in the development of an empowered STEM workforce for the future. Formal learning focuses on 1) Teacher Professional Development, 2) Mentoring and Research Infrastructure, and 3) Undergraduate Enrichment. Informal Learning focuses on 1) Enrichment of science clubs/programs and 2) Community outreach events. Many of the goals for EWD were met in year one despite the global pandemic. Some of these offerings were modified to virtual formats or curricula aligned to the needs of teachers/students amidst impacted educational institutions.

Activity WF 1.1a: Facilitate a series of annual Summer Teacher Workshops open to all K-12 educators in the Territory, intensive professional development on pedagogical best practices, ecosystem resilience curricula, STEM content knowledge, STEM career knowledge, and emergent needs.

We scheduled and hosted a meeting with VIDE Science and Math coordinators to coordinate summer workshops. A needs assessment was completed by teachers to determine the particular PD needs in response to COVID-19 changes in instruction. We have not met with R2R faculty to identify workshop themes as of yet. The registration and save the dates for summer workshops are being developed for dissemination to facilitate 50 educators across the 2 islands through a Virtual STEM Institute.

Activity WF 1.1b: Initiate SI PBL-Certificate program to serve as structure for developing and maintaining enhanced PLCs.

Dr. Chris Plyley and Nadia Monroe Mills designed the curriculum for the certificate program to be launched in Fall 2021. The team has worked with the R2R communications specialist to develop a website to host description of program and cohort information.

Activity WF 1.1d: Conduct formative evaluation on PD Program Structure.

Schools and educators experienced disruptions in student instruction due to the COVID-19 pandemic. A needs assessment was done to clarify the needs of local teachers from VI-ISERP. Teachers indicated needs for technological support, distance

learning strategies, student engagement plans, as well as personal/professional support. Teacher Talk Fridays were developed with A total of 10 virtual meetings that included workshops during the academic year covering the identified topics. Assessment and evaluation procedures were conducted and the team is currently conducting analysis for an internal report.

Activity WF 1.1e: Hire two undergraduate student workers, one for each campus.

Drs. Plyley and Monroe Mills created a contract, job description, outlined expectations, advertised positions, and hired two students for Year I Summer; Crystal Carino (STX). Ramiz Hurtault (STT). In year one, we also hired a graduate student, Joash Liburd to provide training and oversight for undergraduate researchers. Mr. Liburd worked on the project as a student assistant for 3 years previously.

WF1.2a: Initiate SI PBL-Certificate program to serve as structure for developing and maintaining enhanced PLCs.

We have not developed the protocols for forming community partnerships. We are developing a sustainability plan to leverage community relationships for future grants and teacher support funding. We presented at the Virgin Island Community Foundation partner meeting to share our work with funders and establish partnerships with local initiatives.

WF1.2b: Hire two Master Teachers on a four year contract to help mentor teachers in PBL certificate programs and to help secure and maintain community partners.

Drs. Plyley and Monroe Mills created job descriptions for the Master Teacher positions. Hiring and advertising will begin in Fall 2021 for a Year 2 post.

WF1.2c: Facilitate culmination event with community partners.

No plans were developed for a culmination event in year 1.

WF1.2d: Establish a Stakeholder Network.

Dr. McSween and Cummings developed a working document of potential stakeholders and contact information. Research of partners included representatives from the DOE,

VIDE, local schools, community STEM organizations, and UVI faculty for inclusion in a VI-ISERP network.

WF3.1a: Support Faculty Mentoring Training/Mentoring Workshops.

Dr. McSween has recruited UVI faculty for mentor training through the Center for the Improvement of Mentored Experiences in Research (CIMER) at the University of Wisconsin in Madison to increase the institutional capacity for effective student support. Due to course shifts due to COVID-19, faculty will complete training in summer 2021. Planned dissemination of training is planned for the academic year 2021-2022.

WF3.1b: Promote use of Undergraduate Student Mentoring Individual Development Plans (IDPs).

Dr.s McSween and Cummings have completed a review of student IDP/compact developed by Dr. Bauman under *Mare Nostrum*. Modified forms were uploaded into a virtual format to increase access and ease use. Dr. McSween has requested the resources be piloted through the undergraduate research program for Summer 2021. Departmental adoption of IDP/ compact will be pursued in Fall 2021.

WF3.1c: Promote R2R research exposure and the use of STEM skills within an education context through an undergraduate practicum program.

We were ot able to establish partnerships with local schools for practicum sites due to COVID-19 closures and the lack of in-person instructions.

WF3.1d: Develop a Graduate Student Professional Development Plan (PDP)/ Listserv.

Drs. McSween and Cummings researched best practices in PDP development for early professionals and located a PDP form employed by a R1 university. A revised form will be designed based on the component identified by this more established program. Meetings with graduate program charis will begin in Fall 2021 to encourage integration of PDP structure into graduate student mentoring. Social Media accounts were created on Facebook and Twitter for the VI-ISERP center to create a hub for communication with defined groups. A group for UVI Grad Students will be developed for dissemination of opportunities, resources, and services in Fall 2021.

WF3.1e: Establish an Integrative Student Support Network.

The student support network at UVI of services for STEM student retention and success has not been developed. Many services and offices were closed due to the COVID-19 pandemic. Efforts to develop this will resume in Fall 2021.

Social Media accounts were created on Facebook and Twitter for the VI-ISERP center to create a hub for communication with defined groups. A group for UVI Early Career Faculty will be developed for dissemination of opportunities, professional development resources, and services in Fall 2021.

WF3.2b: Support Educational Research among Early Career STEM Faculty.

We did not develop the Mini-grant RFP for dissemination. An initial reach out has occurred among R2R faculty for participation in an application review committee.

SYNOPSIS: Undergraduate Education Research Project

Research Lead: Dr. Michele Guannel

Three undergraduate students and one graduate student, working with Dr. Guannel, have led efforts in Science 100 data analysis and assessment. Over the academic year, qualitative analysis of students' lived experiences with the 2017 hurricanes was the focus, producing a baseline understanding of Virgin Islanders' definitions of preparedness and resilience, as well as strength and needs within resilience education. Notably, this research resulted in a presentation at the 2021 Virtual American Educational Research Association (AERA) Annual Meeting on April 10, 2021, entitled "Incorporating university students' lived experiences of disasters in a general education science course," a phenomenological analysis of student essays written about their experiences with Hurricanes Irma and Maria. Dr. Guannel, Dr. Chris Plyley (VI-ISERP), and undergraduate student researchers Ms. Angelisa Freeman and Ms. Bethany Good co-presented this work at the AERA Meeting. Through identifying challenging experiences (Freeman), and types of disaster preparedness (Good), we concluded that the three traditional categories of preparedness (survival, planning, and structural preparedness) are lacking an acknowledgement of a fourth type of preparedness, which we are describing as emotional, spiritual, and social preparedness. This fourth category of preparedness represents the human side of resilience in terms of strategies employed in the anticipation, experience, and aftermath of major natural disasters and other emergencies, and has been noted in findings of other researchers regarding characteristics that make some communities more "resilient" than others, following major disasters.

New analyses of disaster preparedness and a Post-Traumatic Growth framework, conducted by Freeman and Good, were incorporated into the manuscript entitled, "A course on natural disasters gets real: living the impacts of climate change in the US Virgin Islands," a chapter within the book, "Social justice in climate change education: Exploring social and ethical dimensions of environmental education." Co-authors on the book chapter include Dr. Greg Guannel, Ms. Imani Daniel, and UVI graduate Ms. Nailah Copemann. This book is currently in press with publication slated for 2021.

Development of experiential learning in SCI 100 and SSC 100 revealed common themes that can serve as foundations for an integrated Freshman Year Experience based upon high-impact practices. In SCI 100, fully virtual student projects investigated the science versus community perceptions of COVID-19 and COVID-19 vaccines, development of social media platforms for education on natural disasters, and

hydroponics for food security, for a total of 18 projects completed in Science 100 over the fully virtual 2020-2021 academic year. New, project-oriented SSC 100 modules focused on topics such as “Vaccine Science and Addressing Community Skepticism,” “Pandemic Public Health and Preventing Community Spread,” and “Mental Health and the COVID-19 Pandemic.” Drs. Guannel and Perry participated in the development and moderation of a UVI COVID-19 Town Hall in March 2021. Drs. Guannel and Perry also presented two service learning workshops, in collaboration with Ms. Julie Cruz (UVI’s Center for Student Success) and Dr. Guannel’s undergraduate student service learning coordinator, Ms. Deanna Hunt. One freshman student co-mentored in SSC 100 (Dr. Perry) and SCI 100 (Dr. Guannel), Mr. Luis Chevalier, conducted interviews of 30 individuals regarding reasons for selecting COVID-19 vaccination or not, finding that about half of the individuals did not want to obtain the COVID-19 vaccine, with lack of trust in medical systems being a major factor. Mr. Chevalier presented his findings to the Territorial Children and Youth Disaster Task Force, a consortium of youth-serving organizations, in April 2021. Finally, Dr. Guannel and Ms. Hunt’s proposal for a workshop entitled, “Student Leadership in Emergency Response and Recovery: From Category 5 Hurricanes to COVID-19,” was accepted for presentation at the Massachusetts Regional Project Kaleidoscope (PKAL) Meeting on June 3, “Back to Normal? STEM Education and High-Impact Practices Moving Forward.” PKAL is a division of the Association of American Colleges & Universities (AAC&U).

Undergraduate Education Research team members hold leadership roles in UVI’s General Education Committee, which includes approximately 15 faculty, staff, and students representing multiple disciplines and both main campuses. As Chair (Dr. Jaeger) and Co-Chair (Dr. Guannel) of this committee, we have begun identifying data sources in collaboration with committee members from Institutional Research and Access and Enrollment branches of UVI. Jaeger and Guannel, along with UVI’s Provost McKayle and two other members of the General Education Committee, are part of a team selected to participate in the AAC&U 2021 Institute on General Education and Assessment, in June 2021. Participation in this virtual institute will further identify UVI-based sources of student tracking.

During summer 2021, the Undergraduate Education Research team members will conduct additional quantitative and qualitative analysis of SCI 100 service learning projects and SSC 100 modules; develop focus group methodology for inclusion in the Institutional Review Board (IRB) project, and develop a concept map of the resilience leaders (RL) program.

Major Accomplishments and Research Findings: Undergraduate Education Research Project

The focus of the undergraduate education research project is to increase recruitment, retention, and persistence of URM undergraduates in STEM and resilience-related majors, minors, and certificate programs, through high-impact practices employed at the freshman and upper undergraduate levels. Initial research focuses on qualitative and quantitative analysis of STEM affinity, 21st century skills, and service learning projects conducted by Science 100 students under the *Mare Nostrum* grant, followed by integration across Social Science 100.

Activity WF 2.1a, Year 1: Analyze existing data from SCI 100 (2018-2020); Develop SSC 100 course with service learning.

Three undergraduate and one graduate student, working with Dr. Guannel, have led efforts in Science 100 data analysis and assessment. Over the academic year, qualitative analysis of students' lived experiences with the 2017 hurricanes was the focus, producing a baseline understanding of Virgin Islanders' definitions of preparedness and resilience, as well as strength and needs within resilience education. Fully virtual projects continued in SCI 100, including community perceptions of COVID-19 and COVID-19 vaccines, development of social media platforms for education on natural disasters, and hydroponics for food security. New, project-oriented SSC 100 modules focused on topics such as "Vaccine Science and Addressing Community Skepticism," "Pandemic Public Health and Preventing Community Spread," and "Mental Health and the COVID-19 Pandemic." During summer 2021, additional quantitative and qualitative analysis of SCI 100 service learning projects and SSC 100 modules will be conducted, to further develop an integrated freshman-year experience that maximizes experiential learning.

Activity WF 2.1b, Year 1: Develop focus group methodology; recruit student & service partner participants. Identify UVI sources of student tracking (Institutional Research).

Dr. Jaeger and Dr. Guannel will develop focus group methodology and recruitment plans during summer 2021. The team will update the Institutional Review Board project accordingly. Drs. Jaeger and Guannel, as members of the General Education Committee of UVI, have begun identifying data sources in collaboration with committee members from Institutional Research and Access and Enrollment branches of UVI. Jaeger and Guannel, along with UVI's Provost McKayle and two other members of the

General Education Committee, are part of a team selected to participate in the Association of American Colleges & Universities (AAC&U) 2021 Institute on General Education and Assessment, in June 2021. Participation in this virtual institute will further identify UVI-based sources of student tracking.

Activity WF 2.2a, Year 1: Investigate structures for resilience leaders (RL) program. Identify employment and schooling goals for the RL program.

Several structures and activities for the resilience leaders program have been identified thus far, including UVI's new interdisciplinary degree programs and the planned UVI Center for Resilience and Sustainability. Individual components of the RL program can be conducted through directed independent research and academic internships with R2R faculty, as well as junior- and senior-level seminar projects across Biology, Social Science, Communication, and other departments. Conceptual mapping of the RL program will be a focus of summer 2021 efforts, and employment and schooling goals will be aligned with Institutional Research data.

SYNOPSIS: Informal Learning

Led by Community Engagement Specialist Jarvon Stout

Despite the many setbacks and restraints brought on by the COVID-19 pandemic, the Informal Learning (IL) component has been able to work with both internal and external partners, as well as utilize innovative technology, to coordinate engagements fitting a virtual and/or hybrid model. These engagements (geared towards community engagement, k-12 outreach and citizen science) have been, and will be, instrumental in progressing IL's mission of engaging local underserved USVI communities in VI-EPSCoR funded research.

Community Engagement:

Working alongside community partners and through numerous collaborations, IL engaged approximately 1,300 USVI residents within year 1. Of these, 1,247 community members viewed/attended two virtual Science Saturday events hosted by the Department of Planning and Natural Resources, which focused on current VI-EPSCoR-funded mangrove restoration and coral disease monitoring research. A total of 54 public volunteers attended the St. Thomas Great Mangrove Cleanup, held in April of 2021. The USVI Glass Recovery Project held its first "Community Dropoff Day" in which 50 VI residents supplied glass waste to be crushed and used in the creation of sandbags.

Youth Engagement:

IL continued to work with major partners such as University Bound (UB) and the Virgin Islands Marine Advisory Service (VIMAS) to engage 83 7th-12th grade students across the St. Thomas/St. John and St. Croix districts through STEM-based kits. Sixty-eight UB students will receive kits containing supplies to create their own at-home hydroponics gardens. Students participating in the Youth Ocean Explorers Summer Program will receive marine science-focused kits to be used throughout the 2021 iteration of the program.

Technology-based Outreach:

IL has begun utilizing web-based tools, 3D printing/modeling technology, and virtual reality software to create place-based products and experiences that will lead to new and innovative ways to further engage target audiences. Over 200 3D models of local species have been created, which will be used in various community engagements and STEM kits tailored for k-12 students and educators. IL has partnered with VIMAS to create the "Mangrove Spy, USVI" project which aims to document biodiversity at mangrove nursery sites through the web-based citizen science platform known as

Zooniverse. The team is also in the early stages of creating 3 virtual reality simulations. These simulations will be used to immerse k-12 students in virtually rendered experiences that imitate VI-EPSCoR funded mangrove restoration, coral disease monitoring and fisheries research.

Major Accomplishments and Research Findings: Informal Learning

Overview:

Despite the many setbacks and restraints brought on by the COVID-19 pandemic, the Informal Learning (IL) component has been able to work with both internal and external partners, as well as utilize innovative technology, to coordinate engagements fitting a virtual and/or hybrid model. These engagements (geared towards community engagement, k-12 outreach and citizen science) have been, and will be, instrumental in progressing IL's mission of engaging local underserved USVI communities in VI-EPSCoR funded research.

Community Engagement:

Science Saturdays: IL participated in two virtual "Science Saturdays" hosted by the Department of Planning and Natural Resources (DPNR). These events, held in January and February of 2021 focused on red mangrove restoration and citizen science efforts, as well as the use of 3D modelling/printing in coral disease research and outreach respectively. Hosted via Facebook Live and Zoom, both events garnered a total of 1,247 views.

USVI Glass Recovery Project: IL, in partnership with the Virgin Islands Marine Advisory Service (VIMAS) launched the USVI Glass Recovery Project. This initiative was started with the goals of reducing glass waste in the Territory's landfills, and creating sandbags to be given to USVI families in preparation for Hurricane season. On March 27th, 2021, the project team hosted its first "Community Drop-Off" event in which a total of 50 community members supplied their glass waste to be used for sandbag creation. A total of 2,148 glass beverage bottles have been crushed to date, equalling approximately 1,200 pounds and leading to the creation of 25 sandbags.

Great Mangrove Cleanup: IL, as a partner for the USVI's first Marine Debris Action Plan (MDAP) committee, assisted in the first socially-distanced Great Mangrove Cleanup of 2021. This citizen science-based initiative was attended by a total of 54 community volunteers who removed, and recorded data on, a total of 1,700 pounds of debris from mixed mangrove stands in National Park forests on the island of ST. Thomas.

K-12 Outreach:

University Bound: IL has maintained its STEM enrichment partnership with the University Bound (UB) program across both the St. Thomas/St. John and St. Croix districts. In lieu of in-person engagements, IL has adopted an at-home, kit based model for UB activities in Spring of 2021. The first STEM activity, scheduled for May to June of 2021, will focus around the concept of Hydroponics gardening and the importance of Food Security in a changing climate, with each student receiving a kit containing the necessary resources to construct and track the progress of their own hydroponics gardens. This will engage a total of 68 local 9th-12th grade students across the Territory.

Youth Ocean Explorers: IL and VIMAS began the creation of take-home marine and environmental science kits for students participating in the 2021 Youth Ocean Explorers (YOE) summer program. These kits will be comprised of 3D printed materials, virtual and augmented reality tools, handheld microscopy equipment which will engage students in a way that is both interactive and promotes critical thinking and creativity. A total of 15 kits are being constructed for each YOE participant across both districts.

Technology-based Outreach:

Mangrove Spy, USVI: An upcoming component to the Mangrove Restoration Project (MRP), Mangrove Spy USVI aims to engage the community through web-based citizen science. This project is being developed by IL and VIMAS with the purpose of allowing community members to assist VI-EPSCoR researchers in documenting the biodiversity in mangrove nursery sites. Project coordinators have been capturing still images of vertebrate and invertebrate species that frequent red mangrove nurseries within John Brewers Bay, St. Thomas. These images are uploaded to the Mangrove Spy, USVI project page on Zooniverse where, once the project is launched, participants can identify and document any and all species present in each image.

3D Printing: In the absence of in-person outreach, IL has invested in 3D printing technology/ modeling software. The team has been utilizing this resource to create locally-relevant representations of terrestrial and marine flora and fauna commonly found throughout the USVI. To date, IL has 3D-printed approximately 200 models. These models are intended to be used in public outreach, as well as STEM-based kits for students across the UB and YOE programs and k-12 educators within the Virgin Islands Institute for STEM Education and Practice (VI-ISERP).

Virtual Reality Simulations: IL and VIMAS have started creating 3 virtual reality simulations. These simulations will allow the team to “bring the ocean to the classroom” in a way that has not previously been done locally. Once completed, each simulation will be based on current VI-EPSCoR funded research and/or citizen science efforts such as mangrove restoration, coral disease monitoring, and fisheries research. k-12 public school students (the target audience for this endeavor) will have the opportunity to virtually enter the spaces in which the research takes place, and interact with virtual representations of researchers while learning about the natural world around them.

SYNOPSIS: Communication and Dissemination

Led by Communication Specialist Elisa Bryan

Year 1, efforts have been focused on a complete redesign of the website viepscor.org. The aim is to provide an overview of R2R goals and introduce the research areas, team members and collaborators while allowing for expansion of the site as the Project matures. Simultaneously, the first magazine-style newsletter under R2R has been designed. Both projects are very near completion and we expect the website launch and newsletter printing to commence in early June 2021.

Major Accomplishments: Communication and Dissemination

All content has been compiled and written for the updated website and Spring/Summer newsletter. These two projects are in the final stages of editing.

A presentation on Infographics and Science Communication was given to Dr. Tyler Smith's Physical and Ecological Processes class in the MMES program. This presentation focused on the importance of effective science communication, the elements required for good design and strategies for creating a compelling, data-rich infographic.

Ms. Bryan has been mentoring a SEAS Alliance Fellow, Zola Roper, as she strives to build her science communication capacity. Under her guidance Ms. Roper manages VI-EPSCoR's social media channels, creates content, and interacts with researchers, students, the general public and other team members to communicate the work being performed in Year 1. She is poised to assist with flooding the social media with R2R information once the new website is completed.

A new logo was designed for VI-ISERP allowing for higher-level branding and recognition.

Major Accomplishments and Research Findings

RESEARCH SUPPORT

Research Equipment / Infrastructure Investments

The University of the Virgin Islands is reinvesting heavily in the reconstruction of the MacLean Marine Science building and the CMES Annex. Both buildings were badly damaged by hurricanes Irma and Maria in 2017. Both buildings were taken completely offline in 2020 and faculty researchers and staff were housed temporarily in other buildings and trailers. With the help of UVI physical plant workers, a series of containers and trailers were erected to house the contents and some personnel during construction. The containers and trailer at the MacLean Marine Science Center are being used for storage, offices, scuba compressor area, workshop, and small lab. This area has been set up with covered outdoor areas for sea tables that allow mesocosm experiments and nurseries for corals and mangroves. The CMES Annex which houses the Environmental Analysis laboratory has been moved into containers and a trailer in its parking lot as construction has required evacuation of the building. Despite these challenges research work continues to grow at these temporary structures.

As of April 12th, 2021, the projection for the completion of the MacLean Marine Science building in October of 2021, and the completion of the CMES Annex is scheduled for August of the same year. The estimated cost of this reconstruction is approximately \$3 Million. Undoubtedly the transition back into the buildings will be a tremendous event, which we greatly look forward to, but moving and setting up of the new facilities will require a considerable commitment of time and energy.

Data Management / Cyberinfrastructure

The Data Management / Cyberinfrastructure team has the overall goal of meeting the data management needs of the R2R team. In year 1, we planned to conduct network throughput and speed tests to determine Internet capacity bottlenecks for researchers, however this task is postponed until year 2, during the Fall 2021 semester. The campus is expected to fully reopen in Fall 2021 so students, faculty and staff will be on campus accessing the campus network and internet. This will ensure that usage will be back to as close to pre-pandemic throughput as possible, in order to successfully test for potential bottlenecks. We have identified, contracted and are currently working with both cabling and fiber optics vendors and UVI's Information Technology Services department to ensure that new and renovated research buildings on both campuses are retrofitted with the latest network cabling and fiber optics, which will increase network throughput

speeds. Additionally, VI-EPSCoR had renewed its University of New Mexico's Earth Data Analysis Center (EDAC) service agreement for ERCORE, a data management database built specifically to handle Track 1 data. ERCORE is hosted at the University of New Mexico and managed by EDAC. We worked with EDAC to erect the new ERCORE site for the new R2R Track 1. We also created a reporting form and policy to ensure researchers provide reporting data monthly.

Major Accomplishments and Research Findings

NON-EPSCOR FUNDING

There were 41 non-EPSCoR-related research proposals that were submitted during the reporting period, totaling a requested \$13,051,067.50. 27 proposals were funded for a total of \$4,127,780, and 31 proposals, valued at \$21,298,074, remain pending and 5 were not funded.

Changes/ Problems

The R2R project has no significant changes to report at this time. The temporary departure of Dr. Sennai Habtes as the component lead for Oceanography is being reviewed by the PI (Waddell) and Co-PI's (Nemeth and Smith). Given that this was a very recent decision, plans to resolve the potential impacts are still in development. The PI will be in touch with NSF-EPSCoR once we have a plan.

Watershed Monitoring and Land Use (WL)		
Goal WL1: Identify sediment flux sources via sediment fingerprinting, and nutrient flux and microbial flux monitoring to characterize the role of runoff in two Virgin Islands watersheds. - Objective WL1.1: Characterize upstream sedimentary runoff sources via UV-Vis spectroscopy. - Objective WL1.2: Characterize nutrient and bacteriological fluxes into the marine environment.		
Objective WL1.1	Specific milestones	
	Year 1	Progress
WL1.1a: Provide training on sediment source tracking procedures to research teams.	Delivery of detailed procedures for sediment trap use and sample collection.	In progress; procedure and prototypes have been developed but have not been finalized pending final field-tests, expected by June 2021.
WL1.1b: Scout locations for sampling and collect permits.	Locations of interest geo-tagged for permitting processes, permits acquired from government and private landowners.	Completed; all study site locations have been identified and geo-tagged, all necessary permits received
WL1.1c: Purchase and install monitoring and sampling equipment: rain gauges, sediment traps, etc.	Sediment traps and weather stations installed in multiple locations within in each watershed.	In progress; some sediment traps have been installed as of May 2021, others have been prototyped and will be installed pending final field-testing, expected June 2021
WL1.1d: Collect and process samples from field research locations.	Sediment source samples collected and processed.	In progress; sediment source sampling has begun but is not complete pending travel to St. John and finalization of sample processing procedure for marine samples
WL1.1e: Interface with other teams for sample collection.	Samples received + quarterly check-in.	In progress; preliminary plan for samplings has been agreed to, but first samplings will not begin till all samplers are installed + sufficient rainfall for sampling event
WL1.1f: Interpret data and determine conclusions for dissemination in community and scientific literature.	Reporting requirements fulfilled.	Completed; preliminary geospatial data interpretation and site characterization data has been analyzed; all reporting requirements fulfilled for Year 1
Objective WL1.2	Specific milestones	
	Year 1	Progress
WL1.2a: Purchase necessary equipment for bacteria and nutrient analysis of water samples and install field equipment.	Equipment purchased and calibrated, installed in field.	In progress; equipment has been purchased but has not been deployed pending travel to St. John (expected June 2021) and receipt of final components (purchased, receipt pending)

WL1.2b: Scout locations for sampling and collect permits.	Locations of interest geo-tagged for permitting processes.	Completed; streamflow sampling locations identified and geo-tagged
WL1.2c: Collect and process water samples.	Samples collected and processed regularly and after runoff events.	Incomplete; no samples collected without sufficient rainfall and without fully installed monitoring sites. First samples could be collected by June 2021
WL1.2d: Interface with other teams for sample collection.	Raw data received + quarterly check-in.	In progress; preliminary plan for samplings has been agreed to, but first samplings will not begin till all samplers are installed + sufficient rainfall for sampling event
WL1.2e: Interpret data and determine conclusions for dissemination in community and scientific literature.	Reporting requirements fulfilled.	Completed; preliminary geospatial data interpretation and site characterization data has been analyzed; all reporting requirements fulfilled for Year 1
Goal WL2: Estimate the downstream impact and ecosystem services rendered by conservation land use interventions. · Objective WL2.1: Before-After Control-Impact (BACI) analysis to provide quantitative estimate of downstream benefit of conservation land use and comparison with reference forest. · Objective WL2.2: Field-scale supporting experiment in agroforestry land uses compared to reference forest for nutrient cycling and water infiltration · Objective WL2.3: Plot-scale supporting experiment in living mulch ground covers in plantain system for nutrient cycling and water infiltration.		
	Specific milestones	
Objective WL2.1	Year 1	Progress
WL2.1a: Design/establishment.	Secure agreements with landowners, install monitoring equipment.	In progress; all necessary permission received, sites identified, and some equipment installed but not yet complete (expected May 2021)
WL2.1b: Sample collection.	Random + post rainfall samplings.	Incomplete; no sampling has taken place in absence of sufficient rainfall for sample
WL2.1c: Sample processing.	Soil samples processed by lab.	Completed; soil samples have been collected and processed for color and particle size analysis in profile
WL2.1d: Data analysis.	Prelim. analysis for reporting reqs.	Incomplete; without sediment catchment samples in absence of sufficient rain, no preliminary analysis is possible
	Specific milestones.	
Objective WL2.2	Year 1	Progress

WL2.2a: Design/establishment.	Secure agreements with landowners and relevant agencies, install monitoring equipment.	In progress; all necessary permission received, equipment is purchased but has not arrived and will be installed pending arrival (expected June 2021)
WL2.2b: Sample collection.	Samples collected from all fields.	Completed; soil samples and site characterizations data has been collected from all fields
WL2.2c: Sample processing.	Soil samples processed by lab.	Completed; soil samples have been collected and processed for color and particle size analysis in profile
WL2.2d: Data analysis.	Prelim. analysis for reporting reqs.	Completed; preliminary geospatial data interpretation and site characterization data has been analyzed; all reporting requirements fulfilled for Year 1
Objective WL2.3	Specific milestones	
	Year 1	Progress
WL2.3a: Design/establishment.	Plantain planting and living mulch establishment.	Completed; plantain was planted in April 2021, living mulch has been collected and is being propagated for ground cover experiment
WL2.3b: Sample collection.	Samples collected from all plots.	Completed; soil samples and site characterizations data has been collected from all plots
WL2.3c: Sample processing.	Soil samples processed by lab.	Completed; soil samples have been collected and processed for color and particle size analysis in profile
WL2.3d: Data analysis.	Prelim. analysis for reporting reqs.	In progress; preliminary analysis has begun based on soil characteristics but will not be complete till living mulch is fully established
Goal WL3: Share communication, community education, and integration activities to support public and stakeholder benefit of the land use research. · Objective WL3.1: Participation in integration activities for community engagement and education outreach. · Objective WL3.2: Provide students with educational and experiential opportunities in science. · Objective WL3.3: Compilation and presentation of results at conferences and in publication.		
Objective WL3.1	Specific milestones	
	Year 1	Progress

WL3.1a: Participate in service-learning/mentoring of SCI-100 and R2R Resilience Leaders students.		Incomplete; event did not take place as of May 2021
WL3.1b: Contribution to R2R newsletter.	Photographs of project and essay produced.	Completed; photographs and essay produced for newsletter
WL3.1c: Creation of lectures and presentations for EOD events.	One presentation or lecture at a sponsored event.	In progress; currently organizing informal presentation for virtual learning event to take place in May 2021
Objective WL3.2	Specific milestones	
	Year 1	Progress
WL3.2a: Participation of undergraduate students in research activities	Engagement of 1 undergraduate in paid participation.	Completed; one student was hired for paid research experience in March 2021 and will continue through the end of Year 1
WL3.2b: Participation of graduate students in research activities.		
Objective WL3.3	Specific milestones	
	Year 1	Progress
WL3.3a: Attendance and presentation at scientific conferences.	Attendance/present at one conference.	
WL3.3b: Publication of results in peer reviewed literature.	Preliminary abstract completed for all research projects.	In progress; all projects have been summarized in the form of a PhD dissertation proposal (Hensley) for eventual publication, and literature review for each publication has also begun

Mangroves and Mangrove Restoration (M)		
Goal M1: Investigate current and historic USVI mangrove distribution, recovery, and loss. · Objective M1.1: Years 1-3: Document historical and current mangrove extent and estimated species composition across the territory using archival information and the application of new technology. · Objective M1.2: Years 1-5: Document the current status and recovery of mangroves using aerial imagery and long-term field plots.		
Objective M1.1 Years 1-3: Document historical and current mangrove extent and estimated species composition across the territory.	Specific milestones	
	Year 1	Progress
M1.1a: Compile current and historical aerial imagery.	Compilation initiated: Open-source images complied. Private imagery prices identified. Gap analysis used to determine priority imagery for purchase, and purchases completed. Communications with collaborators regarding potential for shared imagery discussed.	Completed; compilation initiated.
M1.1b: Compile historical maps and charts.	Initiation of online and in-person searches for historical maps and charts containing mangrove distribution information. This will include communications with the Danish and US archives, local historical societies and organizations, territorial libraries and/or other resources as they arise.	Completed; compilation initiated.
M1.1c: Take new drone imagery of mangroves across the territory.	Identification of priority USVI mangrove sites for drone imagery collection. Team becomes acquainted with drone flight operation & imagery processing software. Imagery collection begins.	In progress; sites are identified, team has become familiar with the steps needed to become legally authorized to fly in the USVI and has started those steps. We have investigated image processing options, but no acquisition of images have begun.
M1.1d: Create atlas (map mangrove extent over time).	Creation of a Geodatabase where aerial imagery, historical maps and new drone footage is cataloged as it is acquired. Resources geo-referenced, as needed. Mangrove mapping methods established and mapping begins.	In progress; draft database started but we are delayed on establishing methods for mapping as we are still acquiring data sources and need to assess what will work best across those.

M1.1e: Atlas and historical narrative shared.		
Objective M1.2 Years 1-5: Document the current status and recovery of mangroves using aerial imagery and long-term field plots.	Specific milestones	
	Year 1	Progress
M1.2a: Site selection.	Finalization of research sites coordinated with other research areas.	Completed; Fish Bay, St. John and Salt River, St. Croix were selected in coordination with other R2R research areas.
M1.2b: Apply for permits.	Permits drafted, submitted, and approved.	Completed; all territorial and federal permits have been drafted, submitted and approved.
M1.2c: Conduct repeat drone surveys of sample sites.	Drone surveys completed (2x per year)	In progress; additional licensure and accreditation needed to legally fly drone to collect these data. Process has been investigated and started.
M1.2d: Document areas of existing canopy extent, damage, and dead trees at study sites.	Drone survey aerial imagery georeferenced, mapping completed for that year's imagery	Incomplete; unable to legally collect drone imagery.
M1.2e: Analyze mapping data to estimate percent mortality and percent recovery.	Completed analysis of year 1 data.	Incomplete; unable to legally collect drone imagery.
M1.2f: Assess new mangrove growth.	Develop and complete field methods for rapid assessment of new mangrove growth, to be completed at main sample sites and potentially at additional sites across the territory.	In progress; methods developed and materials ordered. Fieldwork to begin in May 2021.
M1.2g: Establish and re-survey long term mangrove plots within research sites.	Determined location of long term plots within each site, developed and finalized a long term monitoring methodology using pre-existing USGS methods, established and surveyed the plots.	In progress; locations TBD, but methods established. Fieldwork to begin in May 2021.
M1.2h: Analyze long-term monitoring plot data.	Completed analysis of year 1 data.	In progress.

M1.2i: Analyze cores for carbon storage.	Collected sediment cores at long-term monitoring site locations. Completed laboratory analysis of cores for organic matter (OM) as a proxy for carbon content. Initial analysis of year 1 cores completed.	In-progress; materials ordered, fieldwork to begin in May 2021.
M1.2j: Share long-term monitoring results.		
Goal M2: Grow USVI Mangrove Restoration Opportunities. · Objective M2.1: Years 1-5: Examine where and how mangrove restoration can be implemented in the USVI · Objective M2.2: Years 3-5: Field test different mangrove restoration techniques to understand factors affecting resilience of seedlings. · Objective M2.3: Years 1-5: Grow the mangrove citizen science program. · Objective M2.4: Years 2-5: Evaluate the impacts of the mangrove citizen science program.		
Objective M2.1 Examine where and how mangrove restoration can be implemented in the USVI.	Specific milestones	
	Year 1	Progress
M2.1a: Apply for mangrove propagule collection permits.	Permits drafted, submitted, and approved.	Completed.
M2.1b: Prepare, develop, and maintain a land-based nursery for mangrove seedling grow-out.	Researched mangrove nursery methods. Acquired materials and supplies needed for establishment of nursery infrastructure. Nursery established and fine-tuned to support sapling growth of all local mangrove species if possible.	Completed; methods researched, materials and supplies acquired, plumbed et nursery constructed (8 tables with 24, 45 gallon tanks).
M2.1c: Collect mangrove propagules for nursery stocking.	Propagule collection sites determined. Propagule tracking/tagging methodology established. Mangrove nursery database established. Initial propagules collected, tagged, added to the database and transferred to the nursery.	In progress; collection sites determined, initial propagules collected, database still under development.
M2.1d: Conduct water-table and field grow-out experiments.	Established experimental design for water-table and field grow out experiments for mangrove saplings. Experiments initiated and maintained. Results added to mangrove nursery database.	In progress; design almost completed, expect to begin in June 2021.
M2.1e: Analyze mangrove nursery grow-out experiment results.	Analysis of year 1 nursery data initiated.	In progress; data collection to begin in June 2021.

M2.1f: Mangrove nursery grow-out methods, best practices, and results shared.		
Objective M2.2 Field test different mangrove restoration techniques to understand factors affecting resilience of seedlings.	Specific milestones	
	Year 1	Progress
M2.2a: Determine mangrove restoration sites.		
M2.2b: Apply for mangrove outplanting permits.		
M2.2c: Conduct restoration experiments to investigate effects of spacing and bioturbator abundance on seedling resilience.		
M2.2d: Analysis of restoration experimental data.		
M2.2e: Mangrove restoration experimental outcomes shared.		
Objective M2.3 Grow the mangrove citizen science program.	Specific milestones	
	Year 1	Progress
M2.3a: Coordinate with existing partners and seek new partnership opportunities to support program development	Meet with partners to discuss program goals and strategies	Completed; met with VIMAS, NPS, H. Levity Stoutt Community College, USGS, DPNR.
M2.3b: Recruit program participants.	Develop recruitment materials. Advertise and begin participant recruitment	In progress; recruitment materials are being developed to align with program goals and strategies.
M2.3c: Engage participants in mangrove restoration activities.	Engage participants in mangrove grow-out activities	Incomplete; we anticipate this will begin in July 2021 as the new post doc comes on board.
Objective M2.4 Evaluate the impacts of the mangrove citizen science program.	Specific milestones	
	Year 1	Progress
M2.4a: Obtain UVI IRB approval.		
M2.4b: Develop and test assessment instruments.		
M2.4c: Collect participant data.		
M2.4d: Analyze participant data.		

M2.4e: Communicate and build on research findings.		
Goal M3: Share USVI Mangrove Research with Stakeholders & Provide Opportunities for New Partnerships. · Objective M3.1: Years 1-5: Share mangrove research through Integration Activities (planned EOD and VI-ISERP activities, community events, and other opportunities). · Objective M3.2: Years 1-5: Provide opportunities for student training and enrichment. · Objective M3.3: Years 1-5: Participate in professional development opportunities that boost communication of research and strengthen partnerships.		
Objective M3.1 Share mangrove activities through Integration Activities (planned EOD and VI-ISERP activities, community events, and other opportunities).	Specific milestones	
	Year 1	Progress
M3.1a: Integration Activity: Share research through VI EPSCoR channels (e.g., promotions, announcements & blog posts).	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Allow time for interviews and development of blog posts. Contribute 2 products or events per year.	Completed; content provided for 6 social media posts on instagram.
M3.1b Share research through community outreach events (e.g., Reef Fest, Sip N' Science)	Participate in 1 event per year	Completed; 2021 St. Thomas Great Mangrove Cleanup.
M3.1c: Integration Activity: Participate in VI-ISERP activities.		
M3.1d: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	Completed; materials and revisions provided.
M3.1e: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Completed; materials and revisions provided for the newsletter.
Objective M3.2 Provide opportunities for student training and enrichment.	Specific milestones	
	Year 1	Progress
M3.2a: Engage undergraduate students in mangrove research.	2 undergraduates engaged.	In progress; two UVI undergraduate students interviewed for summer research opportunities in the Gries lab and will begin in June

M3.2b: Engage graduate students in mangrove research.	2 graduate students engaged.	Completed; 4 UVI MMES students recruited to work on mangrove research and restoration goals.
M3.2c: Explore synergies for student training and enrichment with other partners and programs.	Opportunities explored as they arise.	Completed; opportunities leveraged with the SEAS Islands Alliance and NRT Strong Coasts.
Objective M3.3 Participate in professional development opportunities that boost communication of research and strengthen partnerships.	Specific milestones	
	Year 1	Progress
M3.3a: Participate in R2R writing workshops.	Workshop participation.	Incomplete; delayed to Year 2.
M3.3b: Attend and share research efforts at local, national and international conferences.	Participate in 1 conference per year.	Completed; 8 presentations at local, national, and international conferences.
M3.3c: Integration Activity: Attend annual VI EPSCoR Conference.		

Emerging Areas: Brewers VPS Array, Beaches, Seagrass, Sargassum (EA)

Goal EA 1. Determine the impacts of invasive seagrasses that alter movement, habitat, and food resources for fish and sea turtle species and the growing effects of large volumes of Sargassum.

- **Objective EA 1.1:** Install Innovasea fine-scale positioning system to monitor the movement of tagged macrofauna (sea turtles, fish, and conch) in areas of changing seagrass communities.
- **Objective EA 1.2:** Acoustically tag an sea turtles and fish utilizing these areas susceptible to changes in seagrass communities and influxes of sargassum to monitor their movement and relative population size.
- **Considerations:** local permits are expected to be accessed through VI-DPNR relatively easily, National Marine Fisheries Permits to handle turtles is under review. If the NMFS permit is declined Dr. Jobsis has been in discussion with Dr. K. Hart (USGS) for this project to be added to her current NMFS permit.

Objective EA1.1	Specific milestones	
	Year 1	Progress
EA1.1a: Obtain permitting and equipment; ordering required for tagging sea turtles and fish.	Receive ten year NMFS permit, two year local permit, and equipment orders received.	UVI's IACUC board approved the research plan, The local Department of Fish and Wildlife permit for array installation and outreach with sea turtle project has been submitted. The national permit for inwater work with turtles was returned and will be resubmitted. The research can begin in July under the NOAA / NMFS permit of USGS researcher, Dr. Kristen Hart.
EA1.1b: Install acoustic receivers, Hobo temp loggers, DO2 Loggers.	Design and order additional Innovasea receivers, tags and batteries	The acoustic array has been designed and the appropriate tags, receivers and batteries have been ordered
EA1.1c: Acoustic tracking student and postdoc engagement for turtle and fish tracking in changing seagrass beds, and sargassum events.	Attract and enroll students interested in invasive seagrass and Movement Ecology/acoustic tracking. Advertise for Acoustic tracking Post-doc	MMES students Andrew McGregor and Taylor Brunson have been recruited to conduct research on movement ecology in Brewers Bay. Candidates for the Acoustic Tracking Post-doc have been interviewed.
EA1.1d: Dropcam and sample seagrass beds quarterlyrandomly sampled in 100cm2 subplots quarterly		NA
EA1.1e: Brewers Bay Water quality sampling.	Collect water samples quarterly and test for standard water quality and nutrients.	Water samples were collected and analyzed by UVI's Environmental Analysis Laboratory
EA1.1f: Outreach and Education.	1 blog post.	Research stories were submitted the VI-EPSCoR newsletter and website, which can be converted to a blog post. A news story was published about the (matching) funds from the National Save the Sea Turtle Foundation.

Objective EA 1.2		
	Year 1	Progress
EA 1.2a: Acoustically tag sea turtles and fish.	Recruit students interested in movement ecology and acoustic tracking.	Completed
EA 1.2b: Tag sea turtles (non-acoustic tags) for mark and recapture population estimates.	Recruit students interested in movement ecology and acoustic tracking.	Completed
Research Team Cohesion: Integration Activity: List communication and collaboration activities developing within teams, across research sites and across disciplines.		Integration Activities: completed discussions with Dr Cruz-Rivera and his student Matt Souza about tagging conch in Brewers Bay; conch tags were purchased. Discussions with Dr. Nemeth (Fish Ecology) about duplication of Reef Bay parrotfish study in Brewers Bay. The two movement ecology studies (Reef Bay and Brewers Bay) personnel meet regularly and have tested equipment together.
Goal EA 2: Quantify the role of seagrass type in short and long-term beach evolution. · Objective EA 2.1: Quantify wave and water column velocities characteristics and difference between two species of seagrass under different conditions. · Objective EA 2.2: Quantify sediment movement and shoreline evolution under different wave conditions, shoreward of different types of seagrass beds.		
	Specific milestones	
Objective EA 2.1	Year 1	Progress
Activity EA 2.1a: Explore selected sites and acquire equipment and obtain permit(s).	Permit received for wave buoy, pressure transducer, and site; Registration and license to fly drones received, with appropriate exemptions for research when and where applicable.	Equipment received and tested. Planning extensive site work in the summer
EA2.1b: Recruit student.	Identify graduate student at UVI or other EPSCoR jurisdiction to perform field work; identify and recruit undergraduate student at UVI to perform field work as appropriate.	Graduate student identified and recruited for Ph.D. position
EA2.1c: Seagrass bed characteristics.		

EA2.1d: Wave measurement and analysis.	Deploy and test wave buoy offshore of seagrass bed, in ~10 m water depth to establish offshore wave conditions outside of the shoaling and breaking region to model wave evolution; deploy and test pressure transducer in shallower water in regions with little or no seagrass for wave model calibration.	Equipment received and tested. Planning extensive site work in the summer
EA2.1e: Wave-induced current measurement and analysis.		
Activity EA2.1f: Align with Objective 1.2b		
Objective EA 2.2	Specific milestones	
	Year 1	Progress
EA 2.2a: Identify site(s), acquire equipment and obtain permits(s).	Permit received for wave buoy, pressure transducer, and site; Registration and license to fly drones received, with appropriate exemptions for research when and where applicable.	
EA 2.2b: Recruit student.	Identify graduate student at UVI or other EPSCoR jurisdiction to perform field work; identify and recruit undergraduate student at UVI to perform field work as appropriate.	Graduate student identified and recruited for Ph.D. position
EA 2.2c: Sedimentation on seagrass beds.		
EA 2.2d: Beach and bathymetric surveys.	Test and establish routine for beach survey and bathymetric survey with single beam sonar data measurement and post-processing.	Equipment received and tested. Planning extensive site work in the summer

Goal EA 3: Measure the spread of the invasive seagrass *Halophila stipulacea* in the territory and the mechanisms affecting its expansion.

- Objective EA 3.1: Measure the distribution and expansion rate of the invasive seagrass.
- Objective EA 3.2: Determine the physiological tolerance of the invasive seagrass to environmental variation.
- Objective EA 3.3: Assess the role of herbivores as top- down control of *H. stipulacea*.
- Objective EA 3.4: Quantify the effect of seagrass type on associated invertebrate communities.

Objective 3.1	Specific milestones	
	Year 1	Progress
EA 3.1a: Select sampling sites , apply for field permits and order tagging supplies.	Long term monitoring sites established; permits obtained; marking and measuring supplies purchased.	Sites have been determined in coordination, two permits have been obtained, some supplies have been obtained
EA 3.1b: Marking seagrass beds and establishing long term transects.	Three <i>Halophila</i> beds at <5, ~15 and ~30 m marked and expansion rate measured 2 times a year.	Will begin summer 2021
EA 3.1c: Monitoring of environmental conditions at expanding <i>Halophila</i> beds.	Measurements of temperature, salinity, PAR and photosynthesis at 2 times a year.	Will begin summer 2021
EA 3.1d: Guidance of M.S. thesis on field.	Recruitment of interested graduate student, begin of student courses and research engagement.	Student Matthew Souza is being funded through this project
Objective EA 3.2	Specific milestones	
	Year 1	Progress
EA 3.2a: Lab experiments on <i>Halophila</i> growth: light and salinity.		Delayed due to lack of research space
EA 3.2b: Lab experiments on <i>Halophila</i> growth: light and temperature.		Delayed due to lack of research space
EA 3.2c: Undergraduate student recruitment and training.		Student recruitment will not proceed until space issues
EA 3.2d: Proposal development.		A proposal with collaborators in FL and PR is in progress
Objective EA 3.3	Specific milestones	
	Year 1	Progress

EA 3.3a: Feeding experiments with <i>Halophila</i> and native seagrasses.	Multiple choice laboratory experiments on relative palatability of <i>Halophila</i> vs. native seagrass	Will be conducted summer 2021
EA 3.3b: Exploration of mechanism of deterrence.	Comparisons of nutrient profiles among studied seagrasses (protein, carbohydrates, lipids, C:N ratios).	Will begin summer 2021
Activity EA 3.3c: Graduate student engagement.	Recruitment of interested graduate student, begin of student courses and research engagement.	M.S. student Jendahye Antoine is finishing her course work to engage in this project; a thesis committee has been formed
Objective EA 3.4	Specific milestones	
	Year 1	Progress
EA 3.4a: Assessments of seagrass invertebrate diversity in <i>Halophila</i> and native meadows.	Long term monitoring sites established based on those of objective 3.1 to include native nearby beds; permits obtained; suction sampling begins twice a year.	To begin in June 2021
EA 3.4b: Description of new species.		Depends on sampling outcomes
EA 3.4c: Proposal preparation.		Proposal being developed
Goal EA 4: Analyze the effects of <i>Sargassum</i> golden tides on Virgin Islands ecosystems. · Objective EA 4.1: Determine genetic diversity of golden tides. · Objective EA 4.2: Measure the effects of <i>Sargassum</i> accumulations of beach biota. · Objective EA 4.3: Measure the effects of decomposing algal accumulations on water quality.		
Objective EA 4.1	Specific milestones	
	Year 1	Progress
Activity EA 4.1a: Establish sampling protocols; obtain permitting; purchase supplies.	Sampling protocols established; permits obtained; molecular genetics supplies purchased.	Sampling protocols have been determined; purchase of supplies is in progress
Activity EA 4.1b: Selecting UAB MS student.	Student identified and begins studies in Marine Biology at UAB.	Student Anna Smith has been recruited to begin studies Fall 2021

Activity EA 4.1c: Collect samples; process samples.	Samples collected from min. 3 sites (~50 thalli per site); samples freeze-dried; DNA extracted.	Starting May 2021
Activity EA 4.1d: Science communication via EPSCOR blog and The Molecular Ecologist/AGA blog	Krueger-Hadfield writes EPSCOR blog and one each for TIME and AGA.	Blog entries are pending on research conducted during travel to the VI. Due to covid restrictions, this will occur in September 2021
Activity EA 4.1e: Capacity building.		
Objective EA 4.2	Specific milestones	
	Year 1	Progress
Activity EA 4.2a: Select sampling sites , apply for field permits and order trapping and preservation supplies.		
Activity EA 4.2b: Measuring Sargassum effects on beach invertebrates with pitfall traps.		
Activity EA 4.2c: Identification and description of species.		
Activity EA 4.2d: Mentoring of a graduate student.		
Objective EA 4.3	Specific milestones	
	Year 1	Progress
Activity EA 4.3a: Permit application, election of sites with and without <i>Sargassum</i> and supplies purchase.		
Activity EA 4.3b: Measuring Sargassum decomposition effects on coastal nutrients.		
Activity EA 4.3c: Measuring <i>Sargassum</i> decomposition effects on coliform abundance.		
Activity EA 4.2d - Capacity building		

Fish Ecology (FE)		
Goal FE1: Advance our understanding of how natural and anthropogenic stressors on coral reefs change herbivore (i.e. parrotfish) assemblages. - Objective FE1.1: Determine if variability in resilience of coral reefs during 2005/2006 mortality event affected the composition of herbivore fish communities (greater shift from <i>Scarus</i> to <i>Sparisoma</i> spp. at low resilience sites). - Objective FE1.2: Determine if variability in sedimentation rates onto coral reefs affected the composition of herbivore fish communities (negative relationship between sediment load and <i>Scarus</i> spp.).		
Objective FE1.1: Determine if variability in resilience of coral reefs during 2005/2006 mortality event affected the composition of herbivore fish communities	Specific milestones	
	Year 1	Progress
Activity FE1.1a: Synthetic analysis of Territorial Coral Reef Monitoring data.	TCRMP fish and coral data compiled and organized from years before (2002-2005) and after (2006-2010) the 2005/2006 bleaching and disease mortality event.	MMES capstone project focused on data synthesis of coral resilience and herbivore communities and grazing rates. A second data synthesis initiated is focused on the response of herbivore community to coral reef decline.
Objective FE1.2: Determine if variability in sedimentation rates onto coral reefs affected the composition of herbivore fish communities (negative relationship between sediment load and <i>Scarus</i> spp.).	Specific milestones	
Activity FE1.2a: Analyze historical data on terrestrial sedimentation rates and structure of herbivorous fish communities	Historical fish and sedimentation data compiled, QA/QC and preliminary statistical analysis completed	Sedimentation data has been compiled in form of manuscript by T. Smith (Henderson et al, in prep).
Goal FE2: Advance our understanding of how benthic characteristics of impacted reefs affect feeding rates and reproduction (frequency of spawning, fecundity) of herbivorous parrotfishes. - Objective FE2.1: Determine if feeding rates of <i>Sparisoma</i> and <i>Scarus</i> spp are affected differently by differences in benthic algal composition and sediment loads. - Objective FE2.2: Determine if frequency of spawning and fecundity of <i>S. rubripinne</i> are affected by differences in benthic algal composition and sediment loads.		
Objective FE2.1: Determine if feeding rates of	Specific milestones	

Sparisoma and Scarus spp are affected differently by differences in benthic algal composition and sediment loads	Year 1	Progress
Activity FE2.1a: Measure differences in sediment flux among parrotfish feeding sites.	Undergraduate student recruited. Sediment trap locations identified and sediment collectors installed in Reef Bay (n=20 distributed within two target feeding areas). Sediment traps collected monthly, sediment flux measured and terrigenous component determined.	Undergraduate student recruited (Keedencia Harris). Sediment traps not installed pending NPS permit approval.
Activity FE2.1b: Measure differences in algal composition and height and sediment load in filamentous algae.	Benthic and algal composition data collection sites identified. Methods for algal composition, turf height and sediment load in filamentous algae initiated.	Data collection sites identified but waiting for NPS permit approval to initiate benthic data collection.
Activity FE2.1c: Measure feeding rates of a Scarus and Sparisoma species in areas that differ in algal cover and sedimentation	NPS research permit application submitted, feeding locations identified, graduate student recruited.	MMES Graduate student Jenna Chermie recruited. Two parrotfish spawning sites and feeding sites identified but still waiting on MPS permit application approval (expected early May 2021)
Activity FE2.1d: Measure differences in parrotfish diet among feeding sites that differ in algal composition and sediment load.		
Objective FE2.2: Determine if frequency of spawning and fecundity of S. rubripinne are affected by differences in benthic algal composition and sediment loads.	Specific milestones	
	Year 1	Progress

Activity FE2.2a: Measure frequency of spawning of <i>S. rubripinne</i> that feed in areas that differ in benthic algal composition and sediment loads.	NPS research permit application submitted, locations for acoustic array identified, equipment purchased. Acoustic receivers installed in Reefs Bay and range testing initiated. Recruiting process for post doc started. Graduate student recruited.	NPS permit submitted January 2021 but still waiting on approval. Locations for receiver array identified but install delayed due to pending NPS permit approval. Existing receivers undergoing QA/QC to ensure functionality. Movement ecology post doc interviews in progress with decision expected by May 15. MMES Graduate student Jenna Cheramie recruited.
Activity FE2.2b: Measure fecundity of <i>S. rubripinne</i> that feed in areas that differ in benthic algal composition and sediment loads.		
Activity FE2.2c: Conduct direct and remote observations of spawning activity of <i>S. rubripinne</i> .	Methods (visual, auditory) developed for remotely recording spawning activity at two <i>S. rubripinne</i> spawning aggregation sites.	Remote camera/hydrophone used to collect preliminary data at primary <i>S. rubripinne</i> spawning aggregation site.
Goal FE3: Improve our understanding of oceanographic and environmental variables that influence reproductive rates (frequency of spawning and fecundity) of coral reef fish that spawn in aggregations. · Objective FE3.1: Determine which oceanographic and environmental variables (current speed and direction, seawater temperature, wave height, salinity, turbidity, wind speed, rainfall) are most important for frequency of spawning at aggregation sites. · Objective FE3.2: Determine which Oceanographic and environmental variables are most important for reproductive output of <i>S. rubripinne</i>.		
Objective FE3.1: Determine which oceanographic and environmental variables (current speed and direction, seawater temperature, wave height, salinity, turbidity, wind speed, rainfall) are most important for frequency of spawning at aggregati.	Specific milestones	
	Year 1	Progress
Activity FE3.1a: Measure oceanographic features at spawning aggregation sites.		

Objective FE3.2: Determine which Oceanographic and environmental variables are most important for reproductive output of <i>S. rubripinne</i> .	Specific milestones	
	Year 1	Progress
Activity FE3.2a: Measure fecundity of <i>S. rubripinne</i> that feed in areas that differ in benthic algal composition and sediment loads.		
Activity FE3.2b: Examine egg and pre-flexion larvae dispersal patterns.		
Goal FE4: Share results of Fish Ecology Research with Stakeholders & Provide Opportunities for New Partnerships. · Objective FE4.1: Years 1-5: Share Fish Ecology research through Integration Activities (planned EOD and VI-ISERP activities, community events, and other opportunities). · Objective FE4.2: Years 1-5: Provide opportunities for student training and enrichment. · Objective FE4.3: Years 1-5: Participate in professional development opportunities that boost communication of research and strengthen partnerships.		
Objective FE4.1: Share fish ecology activities through Integration Activities (planned EOD and VI-ISERP activities, community events, and other opportunities).	Specific milestones	
	Year 1	Progress
Activity FE4.1a: Integration Activity: Share research through VI EPSCoR channels (Promotions, announcements & blog posts).	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Allow time for interviews and development of blog posts. Contribute 2 products or events per year.	Nemeth and Cheramie contributed article on parrotfish project to annual VI-EPSCoR newsletter.

Activity FE4.1b: Share research through community outreach events (e.g., Reef Fest, Sip N' Science).	Participate in 1 event per year.	Shared research on parrotfish herbivory project at informal gathering to generate interest in Sip N' Science at new venue. Nemeth and grad student Kayla Budd participated in Reef Fest mangrove cleanup activity and used opportunity to promote watershed management awareness through mobile app for reporting environmental issues.
Activity FE4.1c: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	Updated VI-EPSCoR website with new information on parrotfish project.
Activity FE4.1d: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Nemeth and Cheramie contributed article on parrotfish project to annual VI-EPSCoR newsletter.
Objective FE4.2: Provide opportunities for student training and enrichment.	Specific milestones	
	Year 1	Progress
Activity FE4.2a Engage undergraduate students in fish ecology research.		Keedencia Harris participated in seagrass research along with R. Nemeth and graduate student Sophie Costa. She is completing her scuba certification and will begin to assist on parrotfish project his summer.

Activity FE4.2b Engage graduate students in fish ecology research.	1 graduate students engaged	Five graduate students engaged in a variety of fish ecology research (Sophie Costa, Kayla Budd, Danielle Olive, Jenna Cheramie and Maksym Cohen), including effects of invasive seagrass on juvenile snapper demographic rates, effects of coral disease on cleaning goby populations, life history characteristics of mutton snapper under different management, effects of sedimentation and benthic algae community on parrotfish life history characteristics and influence of oceanographic patterns on grouper spawning behavior, respectively.
Objective FE4.3: Participate in professional development opportunities that boost communication of research and strengthen partnerships.	Specific milestones	
	Year 1	Progress
Activity FE4.3a: Participate in R2R writing workshops.	Workshop participation.	no progress
Activity FE4.3b: Attend and share research efforts at local, national and international conferences.	Participate in 1 conference per year.	no progress due to COVID
Activity FE4.3c: Integration Activity: Attend annual VI EPSCoR Conference.		Will attend and present at VI-EPSCoR annual conference scheduled 14-15 July, 2021.

Research Team Cohesion: Integration Activity: List communication and collaboration activities developing within teams, across research sites and across disciplines.

Surveyed Fish Bay gut with David Hensley (Activity # WL1.1b, WL1.2b); Working with Tyler Smith on the coral resilience data synthesis (CR1.1d, CR1.2e,f:); Assisted Kristin Grimes with acquiring historical mangrove restoration data from St. John (M1.1b), working with Sennai Habtes on acquisition of oceanographic instrumentation (OC1.1a) and plankton sampling strategy (OC1.2a); Edwin Cruz-Rivera helping on plankton identification for seagrass project (E3.4a) and assisting his student on seagrass sample collections and expansion rates (EA3.1b)

Oceanography (OC)

Goal OC1: Quantify the influence of oceanographic and environmental variables on the variability in reproductive rates (frequency of spawning and fecundity) of *S. rubripinnis*.

- Objective OC1.1: Determine which oceanographic and environmental variables (current speed and direction, seawater temperature, wave height, salinity, turbidity, wind speed, rainfall) are relevant at spawning aggregation sites and other R2R research sites.

- Objective OC1.2: Determine (quantify) the frequency of spawning of *S. rubripinnis* at Reef Bay, St. John.

- Objective OC1.3: Determine fecundity (abundance of eggs and reflection larvae) of *S. rubripinnis* at Reef Bay, St. John during spawning periods;

Specific milestones		
Objective OC1.1	Year 1	Progress
Activity OC1.1a: Deploy suite of oceanographic and environmental sensors and utilize other sources of data from ocean buoys, thermistors, weather stations, etc), including terrestrial R2R measurements if available.	Define desired parameters and spatial/ temporal scales of measurements required to address objective. - Plan and execute site surveys and develop deployment plans and oceanographic and environmental sensor requirements considering important habitat locations and model resolution. -Select the appropriate equipment for experiment sites and secure quotes. - Complete inventory and best use analysis of newly purchased and existing oceanographic sensors, identify appropriate sites, and develop deployment protocols. - Create detailed list of all measured parameters (Oceanographic, Environmental, and Terrestrial) at reef bay site and other sites relevant to Oceanography R2R research.	Full list of available oceanographic data in the US Caribbean is being compiled by Dr. Habtes in collaboration with researchers from the CFMC. A subset of the most suitable data for use in the reef bay study will be combined with UVI long term datasets appropriate for analysis. All data from UVI instrumentation (adcp's, CTD's, hobo loggers) have been QA/QC'd and archived. Current oceanography equipment has been surveyed, 6 new instruments have been purchased and existing equipment maintained and calibrated. Preliminary surveys have been completed at reef bay by R. Nemeth, and descriptions of the sites have been communicated to S. Habtes. Deployment and sampling protocols are in development.

Activity OC1.1b: Examine statistical relationship between oceanic and environmental variables on reproductive output (using data from OCE1.2).	- Develop and organize time-series database, for all oceanographic, environmental, and terrestrial data collected at reef bay site and from other external sources (i.e. ocean buoys, thermistor string, weather stations) OCE1.1a. - Identify appropriate statistical model for examining the influence of oceanic and environmental variables on reproductive output.	Existing UVI time-series data has been QA/QC'd and archived, review of determining appropriate datasets is in progress, along with research to identify appropriate statistical methods for analysis. Further progress was delayed until the data from UVI instrumentation was archived and prepared for analysis, and research in conjunction with the CFMC has identified pertinent longterm datasets in the US Caribbean.
	Specific milestones	
Objective OC1.2	Year 1	Progress
Activity OC1.2a: Conduct plankton tows at spawning sites to determine characteristics of <i>S. rubripinne</i> preflexion larvae and larval starting points for connectivity envelope analysis.	- Complete site surveys at Reef Bay. - Conduct literature search on Scarid and Sparisoma pelagic larval duration and early life history. - Use information from surveys and literature search to design ichthyoplankton survey and collection protocols. - Identify meristic/phenotypic characteristics of larvae or eggs (if possible) to use in analysis. - Advertise for graduate and undergraduate Research Assistants for OCE1.2a/OCE1.3a.	Site surveys at reef bay conducted by R. Nemeth, and site information communicated to S. Habtes during planning meetings. Literature search for Scarid and Sparisoma completed as part of completed MS research by K. Ewen. Survey design is in progress, delayed due to leave of absence requested by S. Habtes until determination of sampling abilities and priorities determined by R. Nemeth. Recruitment of undergraduate and graduate students within oceanography delayed until succession plan for lead researcher within the oceanographic research area is determined.
	Specific milestones	
Objective OCE1.3	Year 1	Progress

Activity OC1.3a: Collect eggs at spawning sites to identify fecundity potential during spawning aggregations and understand the influence of oceanographic and anthropogenic	- Complete site surveys at Reef Bay, use information to design collection of egg clouds via SCUBA/ship. - Design SCUBA/ship net sampling egg collection apparatus. - Design survey and collection protocols for egg collection during spawning. - Advertise for graduate and undergraduate Research Assistants for OCE1.2a/OCE1.3a.	Site surveys at reef bay conducted by R. Nemeth, and site information communicated to S. Habtes during planning meetings. Literature search for Scarid and Sparisoma completed as part of completed MS research by K. Ewen. Survey design is in progress, delayed due to leave of absence requested by S. Habtes until determination of sampling abilities and priorities determined by R. Nemeth. Recruitment of undergraduate and graduate students within oceanography delayed until succession plan for lead researcher within the oceanographic research area is determined.
Goal OC2: Determine larval dispersal pathways from point-source spawning aggregation sites of <i>S. rubripinne</i> . · Objective OC2.1: Use ichthyoplankton abundance data and regional ROMS model to model dispersal, and if possible retention, pathways. · Objective OC2.2: Increase the resiliency of the oceanographic research capacity (personnel and equipment) within UVI.		
	Specific milestones	
Objective OC2.1	Year 1	Progress
Activity OC2.1a: Develop realistic and accurate hydrodynamic outputs from the US Caribbean Regional Ocean Modelling System for use by the Connectivity and Biodiversity research component and a wider audience of US Caribbean stakeholders.	- Develop an US Caribbean coastal ocean model (USCCOM) based on the ROMS architecture with fine resolution nested grids for STX and STT/STJ (300 m) that cover the R2R research sites. - Iterative testing of the nested grid outputs compared to current and temperature measurements in the nearshore areas. - Develop LTRANS connectivity module to model larval dispersal of <i>S. rubripinne</i> , <i>E. striatus</i> , <i>L. analis</i> from spawning locations.	The US Caribbean Coastal Ocean Model (USCCOM), a primitive equation numerical modeling system for the US Caribbean coastal ocean based on the ROMS AGRIF (Regional Ocean Modeling System with Adaptive Grid Refinement in Fortran) architecture developed. Post-doc S. Mukherjee is familiarizing himself with the use of the LTRANS module for dispersal module with USCCOM outputs.

Activity OC2.1b: Integrate oceanographic variables, coral reef condition, parrotfish reproductive output, and connectivity models parameterized from regional ocean models and time series of synoptic remotely sensed data (Chlorophyll a, Sea Surface Temperatures, Sea Surface Height Anomalies, etc)	- Summarize all available oceanographic, environmental, and terrestrial R2R data for use in mixed statistical model. - Identify appropriate statistical model and parameterization.	Full list of available oceanographic data in the US Caribbean is being compiled by Dr. Habtes in collaboration with researchers from the CFMC. A subset of the most suitable data for use in the reef bay study will be combined with UVI long term datasets appropriate for analysis. All data from UVI instrumentation (adcp's, CTD's, hobo loggers) have been QA/QC'd and archived
Objective OC2.2	Specific milestones	
	Year 1	Progress

		A list of available vendors and quotes for suite of necessary equipment and upgrades to the vessel required for development of an operational coastal oceanographic research vessel is under development by Dr. Habtes, and will be delivered to VI EPSCoR administration prior to his leave of absence. They can decide on how to proceed once a determination has been made on whether to continue a the vessel program without a lead oceanography researcher, or when one has been put in place. Drs. Habtes, Jobsis, and Wilson have identified at least 3 sources of funding and have been collaborating on developing the preliminary documents to use in submission of proposals. A working group of VI EPSCoR researchers and administration and at least 4 outside members which have vessel program experience has been developed. We are still awaiting an organizational chart of vessel management responsibilities from VI-EPSCoR Admin and CMES director.
OC2.2a: Develop more permanent physical and human infrastructure to conduct oceanographic research.	- Solicit quotes, and select contractors, and begin 55' Derecktor ANB oceanographic equipment upgrades. - Complete vessel stability testing and design of winch and frame for installation. - Secure at least 2 extramural funding sources (i.e. NSF MRI proposal or CariCOOS EOI) to supplement salary for oceanographic personnel and needed equipment upgrades for coastal research vessel. - Develop working group for vessel management, use, and associated infrastructure for vessel maintenance and development. - Review and approve Org chart for vessel management and operations (in development by VI-EPSCoR Admin and CMES director.	
Goal OC3: Share USVI Oceanography Research with Stakeholders & Provide Opportunities for New Partnerships		
· Objective OC3.1: Share oceanography research through Integration Activities (planned EOD and VI-ISERP activities, community events, and other opportunities).		
· Objective OC3.2: Provide opportunities for student training and enrichment.		
· Objective OC3.3: Participate in professional development opportunities that boost communication of research and strengthen partnerships.		
Objective OC3.1 Share oceanography research through Integration Activities (planned EOD and VI-ISERP activities, community events, and other opportunities)	Specific milestones	
	Year 1	Progress

OC3.1a: Integration Activity: Share research through VI EPSCoR channels (Promotions, announcements & blog posts).	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Allow time for interviews and development of blog posts. Contribute 2 products or events per year.	Provided submissions to VI EPSCoR for annual newsletter and website.
OC3.1b: Share research through community outreach events (e.g., VI-EPSCoR Annual Conference)	Participate in 1 event per year.	co-authors on two published papers (Marine Ecology Progress Series & Aquatic Botany), and authors on one submitted paper under review (Journal of Operational Oceanography. Three presentations on our research at conferences, workshops, and online meetings. A presentation and panel discussion at the 2020 SACNAS, National Diversity in STEM Conference; a panel discussion for the GEO REU Workshop Series: Elements of an REU; and a panel discussion for #BlackinMarineScienceWeek.
OC3.1c: Integration Activity: Participate in STEM Faculty Support, Resilience Leaders, and Service Learning Program activities.	Coordinate with EOD to develop integration activities in STEM Faculty Support, Resilience Leaders, and Service Learning Program activities.	Participated in EOD surveys to identify interest for collaboration. Collaborations are planned for later years.
OC3.1d: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	Website text was developed and published on the website in February 2021.
OC3.1e: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Developed newsletter article on the development of the USCCOM, March 2021
Objective OC3.2 Provide opportunities for student training and enrichment.	Specific milestones	
	Year 1	Progress
OC3.2a: Engage undergraduate students in oceanography research.	Advertise and recruit.	Delayed due to leave of absence by S. Habtes
OC3.2b: Engage graduate students in oceanography research.		

OC3.2c: Explore synergies for student training an enrichment with other partners and programs.	opportunities explored as they arise.	developed opportunities for collaborative research between R2R and NSF Strong Coasts NRT.
Objective OC3.3 Participate in professional development opportunities that boost communication of research and strengthen partnerships.	Specific milestones	
	Year 1	Progress
OC3.3a: Participate in R2R Coral Resilience workshop, R2R data working groups, and stakeholder meetings relevant to R2R (i.e. CFMC, DPNR, etc..)	Workshop and working group meeting participation.	S.Habtes chair of CFMC EBFM TAP, attended 2 EBFM TAP meetings and 4 CFMC meetings. R2R Coral Resilience workshop delayed until later in the year or during year 2, and are waiting for scheduled R2R working group meetings later in the year.
OC3.3b: Attend and share research efforts at local, national and international conferences, meetings, or workshops.	Participate in 1 per year.	co-authors on two published papers (Marine Ecology Progress Series & Aquatic Botany), and authors on one submitted paper under review (Journal of Operational Oceanography. Three presentations on our research at conferences, workshops, and online meetings. A presentation and panel discussion at the 2020 SACNAS, National Diversity in STEM Conference; a panel discussion for the GEO REU Workshop Series: Elements of an REU; and a panel discussion for #BlackinMarineScienceWeek.
OC3.3c: Integration Activity: Attend annual VI EPSCoR Conference.		Planned attendance in July of 2021

Marine Disease and Restoration (MD & MR)		
Goal MD1: Determine how species biodiversity affects the spread and impact of coral disease · Objective MD1.1: Test how variability in species assemblages affects disease prevalence across reef habitats · Objective MD1.2: Compare disease incidence among experimental species assemblages		
Objective MD1.1: Test how variability in species assemblages affects disease prevalence across reef habitats	Specific milestones	
	Year 1	Progress
MD1.1a: Quantify disease across species assemblages using existing datasets	Datasets on disease and species composition identified and compiled.	Completed
Objective MD1.2: Quantify disease incidence among experimental species assemblages	Specific milestones	
	Year 1	Progress
MD1.2a: Involve MMES student and undergraduates in experiment.		
MD1.2b: Acquire necessary permits for experimentation.		
MD1.2c: Experimentally test disease transmission in mesocosms with specific species compositions.		
Goal MD2: Determine how local stressors (e.g., nutrients, turbidity) and global stressors (e.g., temperature stress) drive temporal and spatial distributions of disease. · Objective MD2.1: Test effect of water quality and temperature stress on disease prevalence and transmission.		
Objective MD2.1: Test effect of water quality and temperature stress on disease prevalence and transmission.	Specific milestones	
	Year 1	Progress
MD2.1a: Use existing data sets to investigate disease prevalence in relationship to locally driven water quality parameters and temperature stress.		
MD2.1b: Involve MMES student and undergraduate in experiments.		
MD2.1c: Acquire necessary permits for experimentation.		
Activity MD2.1d: Perform lab-based transmission experiment under different levels of temperature stress (levels: no stress, moderate, severe). These experiments will be disease transmission experiments among experimental corals. We will adapt the methods of Williams et al. 2020.		

MD2.1e: Perform lab-based transmission experiment under different levels of local water quality parameters determined to be important in Activity MD2.1a.		
Goal MD3: Predict the spread and impact of multi-species coral disease. · Objective MD3.1: Develop a connectivity-based disease spread model. · Objective MD3.2: Develop species assemblage map for region. · Objective MD3.3: Test effect of influential species assemblage parameters (identified under Goal 1.1) and influential water quality parameters (identified under Goal 1.2) on disease spread model accuracy.		
Objective MD3.1: Develop connectivity-based disease spread model.	Specific milestones	
	Year 1	Progress
MD3.1a: Use hydrodynamic model outputs to parameterize a connectivity model for the northern Virgin Islands.		
Objective D3.2: Develop coral species assemblage map for region	Specific milestones	
	Year 1	Progress
MD3.2a: Identify and combine data sources for coral species assemblages from existing long-term and spatially randomized coral reef monitoring programs	Team assembled and working towards database production of stony coral diversity at long-term sites [links to Coral Resilience Objectives CR1.2a and 1.2b].	Completed
MD3.2b: Produce basic species distribution grid.		
Objective MD3.3: Test effect of influential species assemblage parameters (identified under Goal 1) and influential water quality parameters (identified under Goal 2) on disease spread model accuracy	Specific milestones	
	Year 1	Progress
Activity D3.3a: Hire post-doc		
MD3.3b: Use model framework to determine how species diversity (Goal 1.1) and water quality (Goal 1.2) affect coral disease spread.		
Goal MD4: Share Disease Research with Stakeholders through participation in outreach and education activities. · Objective MD4.1: Share information through planned EOD and VI-ISERP activities. · Objective MD4.2: Participate in professional development activities.		
Objective MD4.1: Share information through planned EOD and VI-ISERP activities.	Specific milestones	
	Year 1	Progress

MD4.1a: Share research through VI EPSCoR channels (Promotions, announcements & blog posts).	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Allow time for interviews and development of blog posts. Contribute 1 product or event per year.	Completed
MD4.1b: Share research through community outreach events (e.g., Reef Fest, Sip N' Science).	Participate in 1 event every other year.	In progress
Activity D4.1c: Integration Activity: Participate in VI-ISERP activities	TDB	In progress
MD4.1d: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	In progress
MD4.1e: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Completed
Goal MR1: Expand capacity for restoration ecology research in the US Virgin Islands. · Objective R1.1: Hire Restoration Ecologist Research faculty.		
Objective MR1.1. Hire Restoration Ecology Research faculty.	Specific milestones	
	Year 1	Progress
MR1.1a: Hire faculty	Develop request for proposal for Research faculty; advertise through UVI Human Resources; Assemble hiring committee; Review applicants.	In progress; position closes April 30, review of applicants to occur in May 2021
Goal MR2: Determine how diversity affects success of coral outplanting. · Objective MR2.1: Compare growth and survival of outplanted corals among different species configurations.		
Objective MR2.1. Compare growth and survival of	Specific milestones	

outplanted corals among different species configurations.	Year 1	Progress
MR2.1a: Involve MMES student and undergraduate in experiments.		
MR2.1b: Acquire necessary permits for experimentation.		
MR2.1c: Perform lab-based transmission experiment under different levels of temperature stress.		
Goal MR3: Determine how gradients in water quality affect success of coral outplanting. · Objective MR3.1: Measure growth and survival of outplanted corals across range of water quality.		
Objective MR3.1: Measure growth and survival of outplanted corals across range of water quality.	Specific milestones	
	Year 1	Progress
MR3.1a: Involve MMES student and undergraduate in experiments.		
MR3.1b: Acquire necessary permits for experimentation		
MR3.1c: Outplanting at sites representing a range of water quality		
Goal MR4: Share Restoration Research with Stakeholders through participation in outreach and education activities. · Objective MR4.1: Share information through planned EOD and VI-ISERP activities.		
Objective MR4.1: Share information through planned EOD and VI-ISERP activities	Specific milestones	
	Year 1	Progress
MR4.1a: Share research through VI EPSCoR channels (Promotions, announcements & blog posts)	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Allow time for interviews and development of blog posts. Contribute 1 product or event per year.	Complete
MR4.1b: Share research through community outreach events (e.g., Reef Fest, Sip N' Science).	Participate in 1 event every other year.	
MR4.1c: Integration Activity: Participate in VI-ISERP activities.	TDB	

R4.1d: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	In progress
R4.1e: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Complete

Coral Resilience (CR)

Goal CR1: Determine the internal and external drivers most critical to coral reef ecosystem resilience in the USVI and identify targets for restoration of resilience.

Hypothesis I (H I): The resilience of USVI's marine ecosystems is reduced through interacting stress drivers but may be modulated through increased genetic and species diversity.

- Objective CR1.1: Create a comprehensive database of external drivers (biophysical regimes) at 42 long-term research sites, with emphasis on describing stressors, disturbance, and other processes that have a potential influence on reef resilience at each location.
- Objective CR1.2: Create a comprehensive database of the internal drivers (biological characteristics and processes) at 42 long-term research sites, with an emphasis on factors that have a potential influence on coral reef resilience.
- Objective CR1.3: Develop metrics describing biological resilience (resistance and recovery) at 42 long-term research sites, including trajectories of diversity and abundance of corals and associated biota
- Objective CR1.4: Identify gaps in knowledge within databases of biophysical drivers and response variables at each location that need additional information.
- Objective CR1.5: Conduct analysis of the influence of biophysical drivers on coral reef resilience across sites, identify most critical internal and external drivers on ecosystem resilience and targets for restoration of resilience.

Objective CR1.1. External Drivers	Specific milestones	
	Year 1	Progress
CR1.1a: Assemble and analyze temperature regimes at long-term coral reef monitoring sites by assembling an expert working group to identify metrics and gaps in knowledge.	Team assembled and working towards database production.	In progress
CR1.1b: Assemble and analyze wave and benthic orbital velocity regimes at long-term coral reef monitoring sites by assembling an expert working group to identify metrics and gaps in knowledge.	Team assembled and working towards database production.	In progress
CR1.1c: Assemble and analyze current regimes at long-term coral reef monitoring sites by assembling an expert working group to identify metrics and gaps in knowledge.	Team assembled and working towards database production.	Incomplete; Awaiting publication of finalized ocean current products
CR1.1d: Assemble and analyze water quality regimes at long-term coral reef monitoring sites by assembling an expert working group to identify metrics and gaps in knowledge.	Team assembled and working towards database production.	In progress

CR1.1e: Compile physical oceanography drivers into geographic surfaces to characterize the physical regimes around the USVI.		
	Specific milestones	
Objective CR1.2. Internal Drivers	Year 1	Progress
CR1.2a: Assemble data of coral species and attribute diversity at 42 long-term coral reef monitoring sites.	Team assembled and working towards database production of stony coral diversity at 42 long-term coral reef monitoring sites.	In progress
CR1.2b: Assemble data and analyze internal drivers of marine disease at 42 long-term coral reef monitoring sites by assembling an expert working group to identify metrics and gaps in knowledge.	Team assembled and working towards database production of disease incidence and diversity at 42 long-term coral reef monitoring sites.	In progress
CR1.2c: Assemble data and analyze internal drivers of nuisance species (Ramicrusta, lionfish) at 42 long-term coral reef monitoring sites.	Team assembled and working towards database of the distribution of Ramicrusta textilis (encrusting red algae) and Pterois volitans (lionfish) at 42 long-term coral reef monitoring sites.	In progress
CR1.2d: Other Invertebrate Diversity at 42 long-term coral reef monitoring sites.	Team assembled and working towards how to assemble a database of invertebrate biodiversity at 42 long-term coral reef monitoring sites.	In progress
CR1.2e: Fish Diversity at 42 long-term coral reef monitoring sites.	Team assembled and working towards database of fish diversity at 42 long-term coral reef monitoring sites.	In progress
CR1.2f: Herbivory at long-term coral reef monitoring sites.	Team assembled, metric of herbivore pressure agreed to, and working towards database of herbivore pressure at 42 long-term coral reef monitoring sites.	In progress
CR1.2g: Management Regimes at long-term coral reef monitoring sites.	Team assembled and working towards database production of management regimes across the 42 sites.	In progress
CR1.2h: Connectivity at long-term coral reef monitoring sites.	Team assembled and working towards modeling of connectivity among 42 long-term coral reef monitoring sites.	Incomplete; Awaiting publication of finalized ocean current products
CR1.2i: Rugosity (proxy) at long-term coral reef monitoring sites.	Team assembled and working towards database production rugosity at 42 long-term coral reef monitoring sites	In progress

CR1.2j: Coral Health (indicator) at long-term coral reef monitoring sites.	Team assembled and working towards database production of coral health (bleaching and partial mortality) at 42 long-term coral reef monitoring sites. Team to determine how to prepare metrics to be best used in the resilience analysis.	In progress
CR1.2k: Coral Interactions at long-term coral reef monitoring sites.	Team assembled and working towards database production of coral interactions (algae, sponges, sediment, predation, territorial damselfish) at 42 long-term coral reef monitoring sites. Team to determine how to prepare metrics to be best used in the resilience analysis.	In progress
Objective CR1.3. Resilience Metrics	Specific milestones	
	Year 1	Progress
CR1.3a: Develop metrics describing biological resilience (resistance and recovery).	Team assembled and analyzing coral cover, abundance, and diversity trends at 42 long-term coral reef monitoring sites.	In progress
Objective CR1.4. Gaps	Specific milestones	
	Year 1	Progress
CR1.4a: Identify gaps and seek additional information.	Collate gaps from working groups and identify gaps that might be important in understanding coral reef resilience.	Incomplete; Deliverables pushed back one year to allow for in-person meeting after COVID-19 restrictions
Objective CR1.5. Analyses	Specific milestones	
	Year 1	Progress
CR1.5a: Lay out framework for statistical models to ensure data is ready.	Layout the framework for the statistical modeling, identify data issues. Identify Bayesian statistical modeler and enact a contract for the work in the project.	
CR1.5b: Conduct analyses of resilience.	Prepare hiring documents for a resilience postdoctoral associate and advertise position.	In progress
CR1.5c: Conduct workshop with participants to go over results of resilience analysis, identify and last tasks, and plan outputs and manuscripts.		

CR1.5d: Prepare synthesis manuscript (s) on drivers of coral reef resilience.		
Goal CR2: Understand the impact of regional larval connectivity patterns on biodiversity patterns. - Objective CR2.1: Develop regional connectivity model for coral reef organisms. - Objective CR2.2: Determine network and habitat connectivity metrics and corresponding estimates of biodiversity. - Objective CR2.3: Analyze the relationship between realized diversity and connectivity, stress, and past disturbances.		
Objective CR2.1	Specific milestones	
	Year 1	Progress
CR2.1.a: Develop model.	Develop connectivity model for the USVI using hydrodynamic model outputs. [Links to OC2.1a and MD3.1a]	Incomplete; Awaiting publication of finalized ocean current products
Objective CR2.2	Specific milestones	
	Year 1	Progress
CR2.2.a: Determine network patterns.		
Objective CR2.3	Specific milestones	
	Year 1	Progress
CR2.3.a: Combine biophysical data sets and connectivity analysis to see if connectivity is related to diversity.		
Goal CR3: Share Coral Reef Resilience Research with Stakeholders through participation in outreach and education activities. - Objective CR3.1: Share information through planned EOD and VI-ISERP activities. - Objective CR3.2: Participate in professional development activities.		
Objective CR3.1: Share information through planned EOD and VI-ISERP activities	Specific milestones	
	Year 1	Progress
CR3.1a: Share research through VI EPSCoR channels (Promotions, announcements & blog posts).	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Allow time for interviews and development of blog posts. Contribute 1 product or event per year.	In progress
CR3.1b: Share research through community outreach events (e.g., Reef Fest, Sip N' Science).	Participate in 1 event every other year.	In progress

CR3.1c: Integration Activity: Participate in VI-ISERP activities	TDB	Incomplete; Deliverables pushed back one year to allow for in-person meeting after COVID-19 restrictions
CR3.1d: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	Completed; Assisted with website content
CR3.1e: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Completed; Assisted with newsletter content

EWD (WF)		
Goal WF1. To integrate resilience research themes (i.e. mangrove restoration, coral reef ecosystems, and land-sea interactions) into teacher professional development to improve K-12 student preparation. . Objective WF1.1: To build STEM community dedicated to developing and implementing research-based best practices in teacher development practices and in student learning using environmental resilience research within the local context. . Objective WF1.2: To build long-lasting STEM community partnerships for increase sustainability of the VI-ISERP center		
Objective WF 1.1	Specific milestones	
	Year 1	Progress
WF 1.1a: Facilitate a series of annual Summer Teacher Workshops open to all K-12 educators in the Territory, intensive professional development on pedagogical best practices, ecosystem resilience curricula, STEM content knowledge, STEM career knowledge, and emergent needs.	One meeting held with VIDE to coordinate summer workshops, needs assessment completed with teachers and R2R faculty to identify workshop themes, summer workshops facilitated for 50 educators.	Met with VIDE and R2R researchers. Needs assessment completed for Summer Institute with R2R faculty inclusion in offerings.
WF 1.1b: Initiate SI PBL-Certificate program to serve as structure for developing and maintaining enhanced PLCs.	Curriculum designed for certificate program. Website created to host description of program and cohort information.	Website in process. Certificate program completed with a online/virtual communication plan.
WF 1.1d: Conduct formative evaluation on PD Program Structure.	Six virtual workshops conducted during the academic year (pedagogy, online teaching, emergent themes), over 300 hours of PD certificates granted. Assessment and evaluation conducted with an internal report.	Completed. Directors for STEM Institute facilitated 10 Teacher Talk Fridays with local teachers to address identified needs from COVID-19 in technology and distance learning pedagogy.
WF 1.1e: Hire two undergraduate student workers, one for each campus	Create contract, job description, outline expectations, advertise positions, hire two students for Year I Summer.	Completed. Hired 2 undergraduate research student workers. Hired a graduate student with travels savings due to COVID-19 to facilitate student training
Objective WF 1.2	Specific milestones	
	Year 1	Progress

WF1.2a: Initiate SI PBL-Certificate program to serve as structure for developing and maintaining enhanced PLCs.	Create protocols for forming community partnerships/begin to foster relationships.	Protocol plans started with mentor teachers in alignment with PBL-Certificate program
WF1.2b: Hire two Master Teachers on four year contract to help mentor teachers in PBL certificate program and to help secure and maintain community partners.	Create contract, job description, outline expectations, advertise positions.	Completed. Created contract, job description, outline expectations and advertising for position
WF1.2c: Facilitate culmination event with community partners	Design Culmination event.	Not started. The disruption of COVI-19 prevented planning.
WF1.2d: Establish a Stakeholder Network.	Research the relevant stakeholders within DOE, VIDE, local schools, community STEM organizations, and UVI faculty for inclusion in a VI-ISERP network.	Faculty and student offices have been identified and alerted of the stakeholder network. A meeting is planned for Fall 2021.
Goal WF2: Increase recruitment, retention, and persistence of URM undergraduates in STEM and resilience-related majors, minors, and certificate programs. . Objective WF2.1: Double the number of first year students participating in STEM and resilience-themed experiential learning opportunities that promote an interest and affinity for STEM, from currently 10% to at least 20%. . Objective WF2.2: Provide 10% of sophomore and junior students with deeper, resilience-themed experiential learning opportunities that promote retention and persistence in a STEM major, minor or certificate program; and STEM-related career goals.		
Objective WF 2.1	Specific milestones	
	Year 1	Progress
WF2.1a: Develop and implement service learning and resilience focused curricula within freshman-level courses (SCI 100 & SSC 100).	Analyze existing quant and qual data from SCI 100 (2018-2020); SSC 100 course development to incorporate service learning & overall social justice theme.	Qualitative data from SCI 100 has yielded two publications in press; additional quant/qual analysis during summer of Year 1 will focus on service learning impacts. SSC 100 course on STT has integrated new modules this year.

WF2.1b: Evaluate the impact of resilience-themed experiential learning on first year students' interest in and affinity for STEM.	Develop focus group methodology; recruit student & service partner participants; identify UVI sources of student tracking (Institutional Research).	Focus group methodology & recruitment plan will be developed in summer of Year 1 with social science faculty. Will continue exploring UVI sources of student tracking during AAC&U Virtual Institute in June 2021.
Objective WF 2.2	Specific milestones	
	Year 1	Progress
WF2.2a: Develop and implement a (sustainable) Resilience Leaders program .	Investigate structures for resilience leaders program (UVI Center for Resiliency and Sustainability, certificate program, Center for Student Success, internships/senior seminars); ID goals for job placement of RL program (% students placed after graduation; breadth of employers/schools).	Discussion has started regarding RL program structures and will be continued during summer of Year 1. Current focus is on new interdisciplinary degrees at UVI, within which the other components can be added. RL program goals will be drafted during summer of Year 1.
WF2.1b: Assess the impact of participation in the RL program on student retention, persistence, and career goals.		
Goal WF3: To support student/ faculty research infrastructure via support for pre and in-service STEM workforce, with the goal to increase STEM career interest, skills, and retention. .Objective WF3.1: To develop mechanisms of support and development for STEM students (undergraduate and graduate) for career skill development, research productivity, and retention. .Objective WF3.2: To develop mechanisms of support and development for early-career STEM faculty for career skill development, research productivity, and retention.		
Objective WF 3.1	Specific Milestones	
	Year 1	Progress
WF3.1a: Support Faculty Mentoring Training/Mentoring Workshops.	Completion of Professional Mentor Training by 2 UVI Faculty.	Two faculty have been recruited for training through the Center for the Improvement of Mentored Experiences in Research (CIMER) at the University of Wisconsin in Madison to be completed by Fall 2021.

WF3.1b: Promote use of Undergraduate Student Mentoring Individual Development Plans (IDPs).	Completed review of student IDP/compact resources Adoption of IDP/ compact.	The IDP/compacts have been reviewed and will be adopted within the summer research program as pilot.
WF3.1c: Promote R2R research exposure and the use of STEM skills within an education context through an undergraduate practicum program.	-Establish partnership with local schools for practicum site development and develop student selection and supervision protocol. - Recruit VI-ISERP teachers with R2R focused PBLs for student integration.	The COVI-19 shifts limited schools capacity to engage in novel partnerships. VI-ISERP teachers will be approached during the STEM institute for participation in Spring 2022.
WF3.1d: Develop a Graduate Student Professional Development Plan (PDP)/ Listserv.	-Best practices in PDP development researched/ PDP form designed and launched in Spring 2022. -Increased STEM graduate student use of PDPs by 20%. -Listserv of Professional Development services and resources for Grad Students launched.	A PDP form was developed. Meetings are scheduled for Fall 2021 with graduate programs for support of adoption. A platform (group) has been developed to engage students and share resources.
WF3.1e: Establish an Integrative Student Support Network.	Support network at UVI of services for STEM student retention and success identified.	Initial invitations have been issued to relevant offices on UVI Campus. A meeting is being organized in Fall 2021 to formalize partnerships and goals of the network.
Specific Milestones		
Objective WF 3.2	Year 1	Progress
WF3.2a: Support of Early Career STEM Faculty.	- Development of annual tracking plan for early career STEM faculty. - Listserv of Professional Development services and resources for STEM Faculty launched.	A platform (group) has been developed to engage early career faculty and share resources.
WF3.2b: Support Educational Research among Early Career STEM Faculty.	Mini-grant RFP for the initial mini-grant recipients released and formation of application review committee.	Partnering with the PEERS Schools out of Rochester Technical Institute, support has been established for application development for faculty doing Educational Research. An initial RFP is being drafted now.

Informal Learning (IL)		
Goal IL1: Increase and sustain the reach of the Informal Learning team throughout the Territory. · Objective IL1.1: Re-establish IL team on the island of St.Croix. · Objective IL1.2: Equal distribution of engagement between St. Thomas and St. John. Objective IL1.3: Increase support staff or personnel to aid in outreach and/or citizen science efforts.		
Objective IL1.1	Specific milestones	
	Year 1	Progress
IL1.1a: Hire Community Engagement Specialist for St. Croix district.	Community Engagement Specialist (CES) will be hired for STX district. STX CES will be trained and familiarized with goals and objectives for Informal Learning.and R2R.	No progress made due to funding restrictions.
IL.1.1b: Creation of IL orientation and training resources.	Create a comprehensive orientation document detailing everything pertaining to Informal Learning.	Creation of this document has been started but it is not yet complete.
Objective IL1.2	Specific milestones	
	Year 1	Progress
IL1.2a: Equal distribution of STT/STJ engagement.	Identify and engage partners, stakeholders who will support activities and initiatives of IL.	IL has begun identifying potential partners, but no engagement has occurred yet.
Objective IL1.3	Specific milestones	
	Year 1	Progress
IL1.3a: Community Partner Recruitment.	Identify groups,organizations and funding sources necessary for hiring and/or recruitment of support personnel.	IL has identified 3 potential groups and/or funding sources to support recruitment of support personnel.
Goal IL2: Diversify range of topics presented in informal education and outreach initiatives. · Objective IL2. 1: Collaborate and communicate closely with R2R researchers. · Objective IL2.2: Partner with community-based groups and/or organizations whose goals and actions fall in line with, and can support/benefit from, R2R outreach and research.		
Objective IL2.1	Specific milestones	
	Year 1	Progress

IL2.1a: Researcher collaboration and communication.	Coordinate meetings with each R2R research theme. The meetings will help to: 1) Improve IL's understanding of R2R research goals and objectives, 2) Effectively align outreach and dissemination efforts with R2R research and secure researcher involvement and, 3) Improve communication/relationship between R2R research faculty and IL team.	IL has begun doing this with several R2R research components.
IL2.1b Outreach menu.	Create a comprehensive document that outlines outreach opportunities by type and date, to secure researcher involvement.	Creation of this document has begun but it is not yet complete.
Objective IL2.2	Specific milestones	
	Year 1	Progress
IL2.2a: Engage community groups.	Meet and form partnerships with, a minimum of 1 organization and/or community group(s) whose work aligns with R2R research and/or dissemination efforts.	We have formed one new partnership with World Oceans School, with the goal of further engaging University Bound students in the geosciences.
Goal IL3: Promote and guide k-12 URM students into the Geosciences and broader STEM pipeline to build a local STEM workforce. · Objective IL3.1: Increase and promote STEM enrichment and exposure opportunities for k-12 students. · Objective IL3.2: Support existing STEM enrichment and/or professional development initiatives through new and existing partnerships.		
Objective IL3.1	Specific milestones	
	Year 1	Progress
IL3.1a: Exposure and Engagement.	Conduct 2 STEM/environmental science-focused outreach activities. 50 k-12 students engaged.	We've participated in two virtual "Science Saturday" events focused on R2R research. We have also coordinated one Ag-based STEM activity for University Bound students. Both initiatives combined reached a total of approximately 1,300 residents with over 100 of these being k-12 students.
	Specific milestones	

Objective IL3.2	Year 1	Progress
IL3.2a: STEM Support.	Support 1 STEM enrichment or professional development initiative for k-12 students and/or educators.	IL provided funding support towards SCUBA certifications for 10 students of the Youth Ocean Explorers program.
Goal IL4: Work toward becoming recognized Hub of information and resources for STEM and environmental education, awareness and sustainability in largely underserved communities. · Objective IL4.1: Become a resource locally and nationally for culturally relevant research that can benefit and assist other universities, stakeholder and partners. · Objective IL4.2 Identify avenues through which the IL team can effectively share the current and ongoing work that has been done ("share our story").		
	Specific milestones	
Objective IL4.1	Year 1	Progress
IL4.1a: Increase collaborations locally and nationally to share information.	Identify partnerships and collaborations with other Universities and organizations who can benefit from R2R research. These partnerships include existing relationships that UVI has regionally and nationally.	No progress made.
	Specific milestones	
Objective IL4.2	Year 1	Progress
IL4.2a: Share our story.	Multiple avenues (conference, workshop, webinar, publication) identified through which IL can share products/disseminate information on R2R research and outreach initiatives.	We have begun identifying workshops and/or conferences through which we can share our work.
IL4.2b: Cross-jurisdiction engagement.	Strengthen and increase communication and engagement with EOD and IL groups from other EPSCoR jurisdictions as well as EOD Council.	IL has participated in monthly EPSCoR-EOD council meetings.
Goal IL5: Build new and improved-upon existing connections and lines of communication to better reach and understand target audiences. · Objective IL5.1: Creation and utilization of culturally responsive assessment tools and surveys.		
	Specific milestones	
Objective IL5.1	Year 1	Progress

IL5.1a: Research and gain a better understanding of the different underserved community groups and what outreach initiatives would be best to reach them.	Identify and establish long-term relationships with community leaders or representatives for previously unengaged audiences (faith-based, non- English speaking, differently-abled etc.). Co-create culturally responsive survey disseminated via the identified community leaders.	We have met, and begun planning potential future collaborations with, an organization that serves the differently-abled and neuro-diverse community on the island of St. Thomas. A co-created culturally responsive survey has not yet been created.
Goal IL6: Build self-sufficiency and innovation within IL team and its efforts. · Objective IL6.1: Pursue funding that puts IL team in a position to be more independent in building out and promoting its initiatives. · Objective IL6.2: Through partnerships and collaborations, sourcing and/or developing tools that innovate both physical and virtual education and outreach efforts.		
Objective IL6.1	Specific milestones	
	Year 1	Progress
IL6.1a: Funding.	Successfully submit for AISL grant. Identify and cultivate 1-2 funding sources.	IL, alongside FL successfully submitted an AISL proposal. IL has begun identifying outside funding sources for its initiatives. One of these potential funding sources has been engaged.
Objective IL6.2	Specific milestones	
	Year 1	Progress
IL6.2a: Acquisition of tools and resources.	Conduct research on viable, innovative outreach tools and strategies.	We have begun looking into, and purchasing, resources that will allow us to incorporate kit-based and virtual outreach going forward.

Communications and Dissemination (CD)		
Goal CD 1: Inform stakeholders and community of R2R Project research and educational goals and progress made toward achieving those goals · Objective CD1.1: Update website viepscor.org · Objective CD1.2: Generate social media content · Objective CD1.3: Write blog posts · Objective CD1.4: Create videos for YouTube Channel · Objective CD1.5: Photo essay series		
Objective CD1.1	Specific milestones	
	Year 1	Progress
CD1.1a: Update website viepscor.org	Overhaul viepscor.org site to reflect new R2R Project team, goals and objectives.	Website is nearly complete and will soon be ready for final editing.
Objective CD1.2	Specific milestones	
	Year 1	Progress
CD1.2a: Generate social media content	Post R2R research relevant content to social media outlets, a minimum of once per week.	Social media postings have been consistently generated. We expect to increase postings once the updated website is published.
Objective CD1.3	Specific milestones	
	Year 1	Progress
CD1.3a: Write blog posts	Write 3 blog posts reflecting R2R Project activities and/or accomplishments.	Year 1 focus has been on writing the website and newsletter. Upon publishing of these items blog posts will follow to promote and expound upon the content found in those publications.
Objective CD1.4	Specific milestones	
	Year 1	Progress
CD1.4a: Create informative videos for YouTube Channel		
Objective CD1.5	Specific milestones	
	Year 1	Progress
CD1.5a: Write and work in partnership with photographer to create a photo essay series reflecting project goals.	Engage a photographer to co-create one photo essay reflecting R2R project goals. Publish the essays on the blog and promote on social media.	Discussions are underway with a photographer/videographer to accomplish this goal.

Goal CD2: Produce a biannual VI EPSCoR Newsletter for broad audiences. · Objective 2.1: Produce two newsletters per year.		
Specific milestones		
Objective CD2.1	Year 1	Progress
CD2.1a: Produce newsletter reflecting Project accomplishments, activities and goals	Write and publish a newsletter in Spring/Summer 2021.	Newsletter is written and in final review before publishing.
Goal CD 3: Support R2R project team's promotional needs. · Objective CD3.1: Create flyers, social media posts and other promotional materials as needed to promote events and activities (i.e.: Reef Fest and Teacher Workshops). · Objective CD3.2: Create various branded support materials for VI-EPSCoR project as a whole (i.e.: project flyers, visual aids, signage, etc). · Objective CD3.3: Continued support of team researchers visual needs.		
Specific milestones		
Objective CD3.1	Year 1	Progress
CD3.1a: Create flyers, social media posts and other promotional materials as needed to promote events and activities. VI-EPSCoR events are branded to ensure high-level, professional representation.	Create promotional materials (flyers, posters, cards, t-shirts, social media posts, etc.) as needed to advertise VI-EPSCoR events. Some (not all) of these events include Reef Fest, STEM Teacher Workshops and Annual Conference.	Flyers, and social media posts have been generated in Year 1. A logo for VI ISERP has been finalized.
Specific milestones		
Objective CD3.2	Year 1	Progress
CD3.2a : Create various support materials for VI-EPSCoR project as a whole. This includes Project flyers, presentations, visual aids, signage, etc.	Create visual support materials as needed.	Materials have been created as needed.
Specific milestones		
Objective CD3.3	Year 1	Progress

CD3.3a : Support team researchers' design needs. This includes but is not limited to infographics, webinars, strategic project promotions and websites (usvistormstrong.org and vicoraldisease.org are examples).	Support team researcher's design needs.	Among the items created in Year 1 are: USVI Storm Strong website, cookbook promotion, summer camp and jobs opportunity promotions; a design and infographic class was taught to Dr. Smith's students, and the creation/design of the Marine Debris Advisory Plan document.
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R2R Management (RM)		
Goal RM1: Meeting the Data Management needs of the R2R team. • Objective RM1.1: Improve University Internet connectivity data transmission throughput and speed. • Objective RM1.2: Build upon core network infrastructure upgrades from 1 Gbps to 10 Gbps to research facilities. • Objective RM1.3 Improve the research data server and storage topology. • Objective RM1.4 Configure the current MS Azure environment to replicate with on-premises data server and storage solution. • Objective RM1.5 Manage data collection and grant reporting data in ERCoRe.		
Specific milestones		
Objective RM1.1	Year 1	Progress
RM1.1a: Multi-home internet connection and increase bandwidth capacity as needed up to 10 Gbps on and between both campuses.	Conduct network throughput and speed test to determine Internet capacity bottlenecks for researchers.	Incomplete - This has been delayed due to Pandemic. The university plans returning to onsite operations in Fall 21.
Specific milestones		
Objective RM1.2	Year 1	Progress
RM1.2a: Upgrade research-related in-building wired and wireless services.	Identify research buildings on both campuses. Work with Contractor to ensure research network needs are met for new construction and existing research facilities.	In progress - Research buildings identified on both campuses, vendor quotes obtained and cabling contractor selected. Work continues with cabling contractor.
RM1.2b: Upgrade fiber optic infrastructure and pathway system for research buildings from multimode to singlemode fiber to support 10+ Gbps building uplink speeds.	Identify research buildings on both campuses. Work with Contractor to ensure research network needs are met for new construction and existing research facilities.	In progress - Research buildings identified on both campuses, vendor quotes obtained and fiber contractor selected. Work continues with fiber contractor.
Specific milestones		
Objective RM1.3	Year 1	Progress
RM1.3a: Expand public cloud services in support of research data needs.	Assessed regularly in partnership with Research/Project Leads and is ongoing throughout the project.	In progress - This is ongoing. Working with research leads to identify storage as needed.
Specific milestones		
Objective RM1.4	Year 1	Progress

RM1.4a: Deploy on-premises research virtual server and storage environment with replication to MS Azure, and possibly other public cloud environments.		In progress - This goal starts in yr 3.
Objective RM1.5a	Specific milestones	
	Year 1	Progress
RM1.5a: Collect data monthly from the researchers via CMES In-Class Report and the Provost Component report for the NSF Annual Report. Store the data in the ERCoRe module for security purposes and ease of access.	Collect data monthly via CMES In-Class Report and the Provost Component report for the NSF Annual Report and store the data in the ERCoRe module for security purposes and ease of access.	Complete - In class form developed and distributed to researchers. Researchers instructed on how to fill out report and how to write narrative for annual report. All data for this year have been input in to ERCore.
Goal RM2: Project Management · Objective RM2.1: Implement project and collaborate with Research/Project Leads, UVI Administration, External Advisory Board, and Governing Committee · Objective RM2.2: Workshop development, logistics, and coordination •Objective RM2.3: Prepare the next USVI Science and Technology Plan		
Objective RM2.1a	Specific milestones	
	Year 1	Progress
RM2.2a: Implement project and collaborate with Research/Project Leads, UVI Administration, External Advisory Board, and Governing Committee.	Conduct weekly team meetings. Conduct 2 per year External Advisory Board meetings. Conduct 2 per year Governing Committee meetings. Meetings are to assess, inform and obtain feedback on project implementation.	Completed- Weekly meetings established. Staff and Research Leads meeting occur bi-weekly. First External Advisory Board meeting occurred Nov 2020 and second is scheduled for July 2021. Governing Committee meeting scheduled in Fall 2021.
RM 2.2b Workshop and Annual Conference development, logistics, and coordination.	Specific milestones	
Objective RM2.3 Prepare the next USVI Science and Technology Plan	Year 1	Progress
RM2.3a: Assess, coordinate and create plan.		In progress - This will be worked on starting in yr 2.

Goal RM3: Collaborating with our External Evaluation and NSF EPSCoR Program teams to meet NSF's expectations for R2R Project Evaluation and Assessment. · Objective RM3.1: External Evaluation · Objective RM3.2: External Evaluation Communication/Attendance at VI EPS Meetings		
Objective RM3.1a	Specific milestones	
	Year 1	Progress
RM3.1a: External Evaluation	Initial planning and evaluation development/Instruments designed/ Leadership interviews held, faculty surveyed.	Completed- Initial evaluation plan created and submitted with annual report.
RM3.1b External Evaluation Communication/Attendance at VI EPS Meetings	R2R Meeting attendance; regular/as-needed communication with PI.	Completed - Attended strategic planning meeting along with two project weekly meetings. Scheduled to attend next project meeting on May 14, 2021.