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

Strategic Plan 2020 – 2025

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VIRGIN ISLANDS EPSCoR

Table of Contents

Executive Summary

The Virgin Islands EPSCoR (VI-EPSCoR) project, "RII Track-1: Ridge to Reef processes and interdependent drivers of Small Island Resilience" (OIA-1946412) addresses 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 Caribbean. However, 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.

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 compliment 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.

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 research will take place primarily on the two campuses of the University of the Virgin Islands (St. Thomas campus and the A. A. Sheen campus on St. Croix), with additional work being done in three other EPSCoR jurisdictions (Louisiana State University (LSU), University of Kansas (KU), and University of Alabama at Birmingham (UAB)). R2R has seven research themes.

Research Theme 1: Watershed Monitoring and Land Use

The Watershed Monitoring and Land Use Team will increase our understanding of terrestrial-based inputs into the coastal and marine ecosystems by connecting land use practices in upland and nearshore habitats to downstream impacts including offshore habitats and reefs. The first research goal is to identify and characterize the sources of sediment flux in two watersheds in the USVI. The second research goal is to characterize the impacts downstream by experimentally testing several conservation land use interventions. The third goal for the team, one that is consistent with each of the other research themes, - is to share communication, community education, and integration activities to educate and inform the public of the benefits of land use research. This research will identify which land uses may be contributing the most to problematic erosion and runoff into the marine ecosystems of the Virgin Islands.

The Watershed Team is led by research agronomist David Hensley, on the Albert Sheen (St. Croix) campus of UVI. This research component will hire one hydrologist and one postdoc. One graduate and one undergraduate student will be supported by this research area.

Research Theme 2: Mangrove Ecosystem Function & Recovery and Mangrove Restoration

The Mangrove Ecosystem Function & Recovery and Mangrove Restoration Team has two major research goals and one shared goal. The Mangrove Ecosystem Function & Recovery goal is to study the current and historic distribution, loss and recovery of the different mangrove species in the territory using a mix of archival maps and new technologies. This effort will help identify the stressors and other factors that influence their current distribution, health, and function in provision-

ing ecosystem services. The goal of the Mangrove Restoration activities is to develop science-based opportunities for restoration by field testing restoration techniques and the factors that influence seedling success and resilience. The Mangrove Restoration activities will also be part of a citizen science program that will engage VI students and citizens alike. The final crosscutting goal is to work with our R2R communications, informal learning and education and workforce development (EWFD) teams to engage the local community including K-12 students, their teachers, and local citizenry. Collectively, this work will result in greater awareness among the public of the value and ecosystem function of mangrove forests.

The Mangrove Restoration Team will be led by UVI's Center for Marine and Environmental Studies (CMES) Assistant Research Professor, Dr. Kristin Wilson Grimes, and assisted by a coastal wetlands technician to be hired. One Mangrove Restoration postdoc, two graduate, and two undergraduate students will be supported.

Research Theme 3. Emerging Areas of Research

Emerging Areas of Research in the R2R project centers on seagrass communities in the shallow waters off of USVI beaches and includes three integrated areas of focus with two research projects specific to Brewers Bay on the southwest coast of St. Thomas. The first goal of the Emerging Areas of Research Team is to improve our understanding of the ecology of the invasive seagrass *Halophila stipulacea* in Virgin Island coastal waters. These research activities will include studies of the invasive grass' distribution and growth rates along with the environmental and physiological variables that influence *H. stipulacea's* distribution. The team will also identify what faunal species utilize the invasive grass as food or habitat.

The interest in seagrasses as part of our exploration of R2R dynamics is, in part, due to their role in moderating wave heights and storing sediments. They are also recognized for reducing shoreline erosion and facilitating recovery of beaches after modest storms. Consequently, the team plans to investigate how different species of seagrass impact wave evolution, wave-induced currents, and associated beach and sediment response, all in an effort to increase understanding on the role of seagrass species in sediment movement in nearshore environments and associated beach response.

The second goal is to determine the effects of local stressors such as sediments, nutrients and invasives including *H. stipulacea* on the movement ecology of sea turtles and fish. These research activities will be supported by the deployment of a high precision acoustic array into Brewers Bay on the southwestern coast of St. Thomas near the UVI campus that will facilitate passive tracking of large vertebrates and invertebrates with ecologically relevant resolution.

The fourth goal of the Emerging Areas of Research Team is to advance our understanding of the large influxes of the brown algae in the genus Sargassum that have inundated coastlines with massive accumulations of this seaweed. The recent change in the increased amounts of the algae have had significant impacts on the coastal tourism and fishing economies from Belize and Mexico to the southern islands in the Lesser Antilles. However, the ecology of the *Sargassum* species is not well known. The Team will study whether the large increases are due to genotypic or phenotypic shifts in the pelagic algal communities, and identify the impacts of the decomposing algae on coastal water quality. This will determine how the algal accumulations affect the biodiversity of the coastal communities.

The Emerging Areas Team is led by three researchers; Associate Professor of Biology, Dr. Edwin Cruz-Rivera, who will head up the *Halophila* and *Sargassum* research with collaborators including: University of Alabama at Birmingham Assistant Professor of Biology, Dr. Stacy Krueger-Hadfield; and University of Kansas' invertebrate zoologist, Dr. Christopher Rogers. This research will support two graduate students and one undergraduate student. The Director for CMES, Dr. Paul Jobis, will lead the research on acoustic tracking and movement ecology studies in Brewers Bay with the support of a postdoc that will be shared with the Fish Ecology Team. Dr. Gregory Guannel, a coastal engineer and head of UVI's Caribbean Green Technology Center, will direct the studies exploring wave and erosion moderation effects by seagrass with the support of a coastal analyst and one undergraduate student.

Research Theme 4: Fish Ecology

The beneficial role of herbivorous fishes on coral reef resilience is well recognized. However, if the rate of coral reef degradation is rapid or coral reef ecosystems have low resistance or recovery potential following disturbance, this may in turn, alter the composition of herbivore communities. The Fish Ecology Team has three research goals. The first goal is to advance our understanding of how natural and anthropogenic stressors on coral reefs change herbivore (i.e. parrotfish) assemblages. The second goal is to understand how benthic characteristics of impacted reefs affect feeding rates and

reproduction (frequency of spawning, fecundity) of herbivorous parrotfishes. The third research goal is to 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. The Fish Ecology Team shares the R2R research teams' crosscutting goal of working with our R2R communications, informal learning and workforce development teams to engage the local community, including K-12 students, their teachers, and local citizenry. This research area will provide a synthetic analysis of the variable influences of watershed processes, coral reef degradation and oceanographic patterns on feeding rates and reproductive output of herbivorous fishes.

The Fish Ecology Team is led by CMES Research Professor, Dr. Rick Nemeth, with support from CMES Assistant Research Professor, Dr. Sennai Habtes. Research activities will share the support for one postdoc with the Emerging Areas of Research Team, and support one graduate and one undergraduate student.

Research Theme 5: Oceanography

The Oceanography Research Team is the hub that links the marine science-related research activities within the R2R project, since variability in oceanographic conditions can be predictors of the drivers influencing coral reef ecosystem resilience. The Oceanography Research Team seeks to understand these drivers by looking at the connectivity and biodiversity among USVI coral reefs, and through understanding the negative feedbacks on herbivorous fish communities associated with differences in habitat and ocean conditions. The Team's first goal is to quantify the influence of oceanographic and environmental variables on the variability in reproductive rates (frequency of spawning and fecundity) of an herbivorous parrotfish *S. rubripinne*. The second goal will determine larval dispersal pathways from point-source spawning aggregation sites of *S. rubripinne*. As with the other research teams, the Team will share USVI oceanography research with the R2R communications and EWFD teams to reach stakeholders and provide opportunities for new partnerships. The research in this area will integrate the influence of oceanographic, environmental, and terrestrial inputs on the reproductive ecology and larval dispersal of a common species of coral reef fish.

The Oceanography Research Team is led by CMES Assistant Research Professor, Dr. Sennai Habtes, with support from Dr. Rick Nemeth. The Team will support Oceanographic Technician, Vanessa McKague; Oceanographic Research Associate, Dr. Sonaljit Mukhergee; and share a collaborator, Assistant Professor, Dr. Dan Holstein, from LSU (with the Coral Resilience team). The Oceanography Research Team will support two graduate and two undergraduate students.

Research Theme 6: Marine Disease and Restoration

The Marine Disease Research Team seeks to understand how diversity affects coral disease, which is an important driver of resilience in coral reef communities. The Team's first goal is to understand how species biodiversity affects the spread and impact of coral disease. Secondly, they want to determine how local stressors (e.g., nutrients, turbidity) and global stressors (e.g., temperature stress) drive temporal and spatial distributions of disease. The third research goal is to predict the spread and impact of multi-species coral disease using a modeling framework that incorporates local hydrodynamics and species distribution maps.

The overarching goal of the coral restoration component is to identify how species diversity and water quality affects the success of coral outplanting. This will be determined by observing how diversity affects success of coral outplanting. Secondly, the Restoration Team will determine how gradients in water quality affect success of coral outplanting. Both the Disease and Restoration teams share the goal of engaging research with stakeholders through participation in outreach and education activities with the Communications and EWFD teams. The research from this area will provide a greater understanding of how species diversity predicts the spread and impact of disease among diverse coral communities, and how diversity affects the potential and success of coral restoration activities.

The Marine Disease and Restoration Team is led by CMES Associate Research Professor, Dr. Marilyn Brandt, and will support one postdoc and one research faculty hire for a Restoration Ecologist, who will assume responsibility for the coral restoration effort upon their hiring in Year 2. The Disease and Restoration component also provides support for two research technicians, two graduate students and two undergraduate students.

Research Theme 7: Coral Reef Resilience

The Coral Reef Resilience Team will investigate how the biodiversity of ecosystems and populations persist and shift through time. The Team defines resilience as the ability of an ecosystem to resist change because of the tolerance of the constituent organisms, and to recover after a disturbance has passed. The first goal will determine the internal and external drivers most critical to coral reef ecosystem resilience in the USVI and identify targets for restoration of resilience. The Team's second goal will seek to understand the impact of regional larval connectivity patterns on biodiversity patterns. The third crosscutting goal is to share Coral Reef Resilience research with stakeholders through participation in outreach and education activities in coordination with our Communications and EWFD teams. The Coral Reef Resilience research will uncover the internal and external drivers behind contrasting resistance and recovery of coral reefs to stress and disturbance in the northeastern Caribbean.

The Coral Reef Resilience Team is led by CMES Associate Research Professor, Dr. Tyler Smith, in collaboration with Dr. Marilyn Brandt, and LSU Collaborator, Dr. Dan Holstein. The team will support one postdoc, one graduate student, one undergraduate student, and a research technician.

Education & Workforce Development

The R2R Education and Workforce Development (EWFD) Team seeks to reduce barriers to achievement in STEM at the K-12 and college levels, in order to meet the need for a large, diverse, highly qualified scientific workforce for emerging STEM markets and technologies here in the USVI. The EWFD team has three goals in regard to STEM workforce development, with a focus on formal learning at pre-college, undergraduate, graduate, and early career levels. EWFD's first goal is 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. The second goal is to increase recruitment, retention, and persistence of UVI's underrepresented minority (URM) undergraduates in STEM and resilience-related majors, minors, and certificate programs. The third goal is to support student/faculty research infrastructure via support for pre- and in-service STEM workforce, with the goal of increasing STEM career interest, skills, and retention. Through a variety of tools, projects based on R2R themes, and engagement activities, the EWFD Team will characterize and quantify improvements in STEM teacher preparation that are expected to increase engagement and facilitate science identities in K-16 URM students across the Territory.

The EWRD Team is led by the Director for Education Research and the Virgin Islands Institute for STEM Education Research and Practice (VI-ISERP), Dr. Lawanda Cummings. The research and education components are led by four UVI faculty members. Assistant Professors of Mathematics, Drs. Christopher Plyley and Nadia Monrose-Mills lead the local STEM K-12 teacher professional development project supporting 2 undergraduate students. Assistant Professor of Biology, Dr. Michele Guannel, will oversee the undergraduate enrichment research on retention and persistence in STEM and resilience pathways through a Service Learning (SL) initiative and Resilience Leaders (RL) programs. The undergraduate program will support 1 undergraduate student over the duration of the grant. Assistant Professor of Biology, Dr. Verleen McSween, and the VI-ISERP Director, Dr. Lawanda Cummings, will lead the mentoring and research infrastructure initiative.

Informal Learning

The goal of the Informal Learning (IL) Team is to advance the comprehensive and culturally responsive Education and Outreach plan that will expand to be more inclusive of URM groups within the Virgin Islands. In addition, the IL Team will increase the level of engagement with existing and new external partners as well as foster collaborations with other universities/research entities. The IL Team has six primary goals. The first is to increase and sustain the reach of the IL Team throughout the Territory. The second Team goal is to diversify the range of topics presented in informal education and outreach initiatives, drawing upon the research outputs and related activities from the R2R research teams. The third goal will promote and guide K-12 underrepresented minority students into the geosciences and broader STEM pipeline as part of the larger R2R objective to build and enhance the local STEM workforce. The fourth goal is to work to become a recognized information and resource hub for STEM and environmental education, awareness and sustainability for the Territory's largely underserved communities. The fifth goal is to build new and improved-upon existing connections and lines of communication to better reach and understand target audiences. The final goal is to build self-sufficiency and innovation within the IL team and its efforts by pursuing funding that puts the IL team in a position to be more independent in building out and promoting its initiatives.

The IL Team is led by Education and Outreach Coordinator Liza Margolis, with support from Community Engagement Specialist Jarvon Stout. The IL Team will support an additional Community Engagement Specialist to be hired in Year one.

Communication and Dissemination

The Communications Team's singular goal is to develop and share information and content that captures the research outputs and related activities emerging from the work and success of the R2R teams and affiliated students. The tools to do so include updates to the R2R website (viepscor.org), the production and dissemination of a biannual newsletter, updates on social media outlets including Instagram, Facebook and Twitter and YouTube. These efforts will be led by Communications Specialist, Elisa Bryan.

Sustainability Plan

R2R will contribute to sustainable capacity at UVI with the hires of two research faculty and four postdocs, all of whom will enjoy strong R2R support. R2R researchers will work to continue and expand their work by applying for external awards from NSF, National Oceanic and Atmospheric Administration (NOAA), US Department of Agriculture (USDA), US Environmental Protection Agency (USEPA), Federal Emergency Management Agency (FEMA), local and regional foundations and NGOs, and from agencies/departments within the Virgin Islands Government. These activities will strengthen the Territory's local technical capacity in the environmental sciences and STEM education. These hires, along with the existing faculty, will be training UVI students who then enter the Government's workforce- for example, the Department of Planning and Natural Resources (DPNR) has hired 4 former graduate students including one who is the current Commissioner and one who leads DPNR's coral monitoring program. More importantly, these hires have successfully pursued federal grants thanks in part to the increased scientific rigor and skills that they've developed at UVI with VI-EPSCoR support. Our EWFD Team has improved the training and professional development of local public STEM teachers, exemplified by the fact that three of the past four "Teachers of the Year" have participated in EWFD's professional development program.

Management, Evaluation and Assessment

R2R adopts a shared leadership model, with two Management Team members running day-to-day operations and a five-person Leadership Team leading science and outreach. Dr. Kim Waddell serves as Principal Investigator/Project Director and Kelly Harrigan as Project Administrator. Oversight will be provided by a nine-member VI-EPSCoR Governing Committee composed of leaders from government, academia, and industry. R2R will be advised by an eight-person External Advisory Board (EAB) of outside experts in R2R-related fields. External Evaluators, Drs. Kelvin Chu and Samantha Brown and members of the TIG Team will collect quantitative data using consistent metrics for longitudinal tracking of activities and outputs, and qualitative data to explore nuances of project work. TIG will provide annual reports, including recommendations which will be used to institute formative changes as appropriate.

Risk Mitigation

The R2R Risk Mitigation Plan assesses the most likely risks that the R2R project and team faces and logical steps to prevent and alleviate them. The largest risks stem from the ongoing Covid-19 pandemic and its short-term disruption of traditional in-person education, research and outreach activities, and the longer term economic impacts on the VI's tourism based economy that will reduce the VI Government's capacity to support the University. The location of the jurisdiction in the hurricane alley in the Northeastern Caribbean poses a seasonal disruption threat that can vary from a two to three day cessation of normal activities for storm preparation to a complete shutdown and national disaster declaration that impacts the entire project for years. More common risks include personnel issues, including potential attrition of key faculty or delays in hiring processes.

Introduction

The U.S. Virgin Islands (USVI) are typical of small island communities across the world and share a number of challenges: limited natural resources, narrow economic base, the constant emigration of young professionals seeking greater economic opportunities, a heavy reliance on outside entities for critical goods and services, and the persistent and increasing impacts from climate change. In the USVI, similar to many tropical and subtropical islands, the nearshore marine ecosystems, especially coral reefs, are key to the economic viability and food security of the islands. However, these reefs and associated habitats are vulnerable to oceanographic and climate change-related disruptions, but also to land and water-based human activities, which often exacerbate the effects of the natural disturbances.

The ability of these natural systems to resist and recover from these disruptions and activities - which we identify as drivers of change - is key to their resilience. Understanding and quantifying these drivers is the focus of *Ridge to Reef: Processes and Interdependent Drivers of Small Island Resilience (R2R)*. This project will provide a more comprehensive understanding of global climate change and local human-induced stress drivers on coral reefs and associated ecosystems. The project will also elucidate the linkages between ecosystems diversity and function, and characterize the ridge to reef land use practices with the development of local terrestrial and marine mitigation strategies. Furthermore, the project will develop research-based best educational strategies for both formal and informal STEM education that focus on USVI and Caribbean-relevant environmental challenges that are also culturally relevant to the diverse cultures and sensibilities found in the Territory. There is also merit and opportunity in the R2R project to improve science communication with the minority-majority populations that can facilitate environmental literacy and action.

The **vision** of Ridge to Reef (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.

Primary Organizational Partners

R2R research and outreach activities will be conducted by faculty, staff, and students at the two campuses of the University of the Virgin Islands (St. Thomas campus and the A. A. Sheen campus on St. Croix), with additional research and training done in collaboration with three universities in other EPSCoR jurisdictions (Louisiana State University, University of Kansas, and University of Alabama at Birmingham). Primary external partners of the Coral Disease and Restoration as well as Coral Reef Resilience Teams include National Oceanic and Atmospheric Administration (NOAA) and the Virgin Islands Department of Planning and Natural Resources. The Fish Ecology Team and Watershed and Land Use Teams have partnerships with the U.S. National Park Service (the Virgin Islands National Park and the Salt River Bay National Historical Park and Ecological Preserve, respectively) as well as with NOAA's National Marine Fisheries Service. The primary partner with the EWFD Team is the Virgin Islands Department of Education.

Alignment With The Virgin Islands Science And Technology Plan

The 2015 Virgin Islands Comprehensive Economic Development Strategy (CEDS) Report serves as the jurisdiction's current Science and Technology Plan (S&T Plan). The CEDS was developed by the CEDS committee, a panel of government, business, community, and academic leaders, many of who provided input on the R2R in their capacity as members of the VI-EPSCoR Governing Committee. The CEDS Report identifies five priorities of which three guide the R2R suite of goals and objectives. These include "Economic Competitiveness" priority whereby the goal is to diversify and grow the economy and create quality job opportunities. An "Education and Skills" priority designed to develop human capital, specifically knowledge, skills, and experience. These two priorities align with R2R's EWFD component goals, and the third priority "Infrastructure, Environment and Quality of Life" which calls for investments to enhance management and conservation of natural resources. This priority crosscuts all research components in the R2R project.

Benefits To The Virgin Islands And To Its Academic Research And Education Infrastructure

The Virgin Islands' coastal ecosystems are of central importance to the Territory's tourism based economy and quality of life for its citizens. However, within this small island territory, what will ultimately determine the future of its social-ecological systems is the ability and capacity of the local community to protect and to actively participate in the stewardship of these environments. Improving the quantitative and scientific skills and educational levels of the USVI workforce by improving STEM education, will be the key to sustainability for the Territory. The R2R research projects will serve as a central focal point to strengthen both formal and informal STEM education, increase the level of environmental stewardship, and lead to better informed decision making in the management of our marine and other natural resources. The evidence-based ecological restoration will also provide a focal point for a Citizen Science Program. A more aware and better educated citizenry will lead to more diversified and sustainable economic development options for the territory. Lessons learned and models developed through our research can be utilized and adapted by other island communities with similar challenges. Specific benefits to the VI's research and education infrastructure include:

- Seven (7) new hires; one (1) Citizen Science Coordinator (Y2 M), one (1) Marine Disease Technician (Y1 MD), one (1) Coastal Technician (Y1 EA), one (1) Environmental Analysis Lab Technician (Y1 EA), and two (2) VI-ISERP teacher support positions (Y2 WF).
- Five (5) Post Doc hires; one (1) Movement Ecology (Y2 shared with EA and FE), one (1) Coral Resilience (Y2 CR), one (1) Marine Disease (Y4 MD), one (1) Mangrove Restoration (Y3 MR), and one (1) Watershed (Y2 WL).
- Planned major equipment purchases; $138k+ investment in research vessel equipment and $100k+ in cyberinfrastructure network and Bayesian Modeler equipment to enhance research.
- Marine Science and Environmental Assessment Lab facilities' construction is underway and is on target to be completed by Fall 2021.
- Facilitating 60-70 STEM teachers' professional development impacting 9,000 grades K-12 students;
- Boosting UVI STEM student graduation rates by 12.5%;
- Preparing 1,000 undergraduate students for STEM career inclusion;
- Supporting18 masters students and 30 undergraduates in marine and terrestrial resilience research; and
- Increasing awareness and participation in environmental resilience by 15%, impacting 2,500 people per year through community outreach, school outreach, and a Citizen Science Program.

The value added will be sustained by nationally competitive research in both Caribbean ecosystems and science education, and sustained transformation of STEM education through strengthened connections between UVI and the Territory's schools. The majority of the Territory's public schools were heavily damaged and or condemned by the 2017 hurricanes. Schools are still occupying modular units, and/or sharing campuses, resulting in challenging learning environments. R2R support of local teachers with professional development and contemporary curriculum content was, and will continue to be, vital for retaining students during the recovery process. The impact of this research will be measured by carefully designed assessments and the value of the new pedagogy will make a compelling case of institutionalizing innovative curriculum.

Project Implementation

Strategic Planning Process

Elements of this Strategic Plan were prepared by members of the R2R Leadership Team beginning in July 2020. On July 15th, 2020, the R2R leadership team met virtually with John Riordan of Cindy Zook Associates for a Strategic Planning prep call. On July 22, 2020, the R2R Research Leads and Leadership Team met for an orientation on strategic planning. Team members prepared the framework for tables and text sections and described their activities. These were discussed and refined at a Strategic Planning meeting, held virtually on August 3-5, 2020, facilitated by John Riordan with NSF EPSCoR Program Directors, Drs. Andrea Johnson and JD Swanson. External Evaluators, Drs. Kelvin Chu and Samantha

Brown were also in attendance. R2R Research Leads and Management Team members then collaborated to complete the strategic plan.

Elements Of The Strategic Plan

The R2R project consists of a number of interdependent and complementary areas and plans that together constitute a diverse, Territory-wide research and education endeavor. Each research area is described in its own text section, accompanied by a table listing goals, objectives and milestones to be reached over the five years of the project. Each separate project objective is also accompanied by a list of outputs, defined as tangible products and benefits of R2R activities, and interdependencies, identifying the researchers and staff who will integrate those products into their own research or activities.

Watershed Terrestrial Monitoring and Land Use

The aim of the Watershed Monitoring and Land Use Team is to connect land use practices in upland and nearshore areas (the "ridge") to downstream impacts (the "reef") by tracking the flux of sediment, nutrients, and microbes in runoff, and quantifying the impact of mitigating land use practices on these fluxes. Watershed-scale monitoring of nutrient and microbial runoff, and sediment source tracking along the ridge-to-reef profile, will focus on the Salt River Bay watershed of St. Croix and the Fish Bay watershed of St. John. The downstream benefits and ecosystem services rendered by conservation land use practices will be experimentally investigated in field-scale and plot-scale studies at other locations in the Virgin Islands. The Watershed Monitoring and Land Use Team will provide the scientific linkages of how land-based human practices impact ecological processes in the estuarine and marine environments. These research activities and findings will be integrated with the activities of the EWFD Team.

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. Understanding the source and composition of sediments will help identify which among the land use practices (i.e., agriculture, construction and road development, or septic tank seepage) may have the most impact in coastal and marine ecosystems. Such information can inform coastal zone management decisions and guide policy in the Territory. The team will characterize upstream sedimentary runoff sources via UV-Vis spectroscopy as well as characterize nutrient and bacteriological fluxes into the marine environment.

Goal WL2

Estimate the downstream impact and ecosystem services rendered by conservation land use interventions. The opportunity to test and compare soil conservation practices with farmers and with road, business and home developers can identify appropriate soil loss mitigation strategies that will reduce sediment pulses into the coastal waters, all to the benefit of coastal and marine ecosystem function and resilience. The Team will utilize Before-After Control-Impact (BACI) analysis to provide quantitative estimates of downstream benefit of conservation land use and comparison with reference forest sites. They will also run experiments to test nutrient cycling and water infiltration in forest and agricultural systems for comparison with the reference forest sites

Goal WL3

Share communication, community education, and integration activities to educate and inform the public of the benefits of land use research. Raising awareness among the public on this key issue, coupled with supporting data to highlight existing practices and sources of soil loss and organic pollution, can inform and motivate farmers, builders and homeowners to mitigate soil loss with improved land use practices across the Territory. The team will participate in integration activities for community engagement and education outreach as well as provide interested students with experiential learning opportunities. The team will also present their research results in conferences and publications.

The impact of this research area will be to allow for practices mitigating land based sediment and pollution to be pursued by the public and private sector of the Virgin Islands which are both pragmatic and informed by scientific evidence.

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.							
	Specific milestones						
Objective WL1.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
WL1.1a: Provide training on sediment source tracking procedures to research teams.	Delivery of detailed procedures for sediment trap use and sample collection.					Hensley/M, EA, CR, and FE teams	Research teams will be prepared to collect sediment samples and prepare for lab analysis.
WL1.1b: Scout locations for sampling and collect permits.	Locations (approx. 12) of interest geo-tagged for permitting processes, permits acquired from government (NPS, DPNR) and private landowners.	Yearly reporting requirements fulfilled to DPNR and NPS (at least 1 each per year)	Yearly reporting requirements fulfilled to DPNR and NPS (at least 1 each per year)	Yearly reporting requirements fulfilled to DPNR and NPS (at least 1 each per year)	Yearly reporting requirements fulfilled to DPNR and NPS (at least 1 each per year)	Hensley/Waddell/ M, EA, CR, and FE teams	Sites identified that are both practicable (physical access) and scientifically applicable with stable legal access.
WL1.1c: Purchase and install monitoring and sampling equipment: rain gauges, sediment traps, etc.	4 land-based and fluvial sediment traps, 2 marine and estuarine sediment traps, and 1 weather station installed within in each watershed.	Maintain and monitor stations and samplers.	Maintain and monitor stations and samplers.	Maintain and monitor stations and samplers.	Maintain and monitor stations and samplers.	Hensley/Students	Rainfall data will be use to govern sediment collections Comprehensive climate data will be available for use in R2R system analysis.

WL1.1d: Collect and process samples from field research locations.	Sediment source samples (approx. 80) and field samples (approx. 48) collected and processed.	Samples (approx. 48) collected and processed.	Samples (approx. 48) collected and processed.	Samples (approx. 48) collected and processed.	Samples (approx. 48) collected and processed.	Hensley/Postdoc/ Students/M, EA, CR, and FE teams	Characterization of sediment source tracking in both "normal" period and as a result of rainfall pulse along downstream linear zone.
WL1.1e: Interface with other teams for sample collection.	Samples received (approx. 24) + quarterly check-in.	Samples received (approx. 24) + quarterly check-in.	Samples received (approx. 24) + quarterly check-in.	Samples received (approx. 24) + quarterly check-in.	Samples received (approx. 24) + quarterly check-in.	Hensley/M, EA, CR, and FE teams	Maintains links with other research teams involved in sediment trap sample collection.
WL1.1f: Interpret data and determine conclusions for dissemination in community and scientific literature.	Reporting requirements fulfilled (1 annual report produced), results disseminated at conference and abstract produced (see WL3.3a and WL3.3b)	Reporting requirements fulfilled (1 annual report produced), results disseminated at conference and abstract produced (see WL3.3a and WL3.3b)	Reporting requirements fulfilled (1 annual report produced), results disseminated at conference and abstract produced (see WL3.3a and WL3.3b)	Reporting requirements fulfilled (1 annual report produced), results disseminated at conference and abstract produced (see WL3.3a and WL3.3b)	Data interpreted to make conclusions with recommendations for final report	Hensley/M, EA, CR, and FE teams	Sediment source information characterized within watersheds to provide stakeholders information to reduce sediment fluxes.

Objective WL1.2	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
WL1.2a: Purchase necessary equipment for bacteria and nutrient analysis of water samples and install field equipment.	Equipment purchased and calibrated, installed in field.	Equipment maintained.	Equipment maintained.	Equipment maintained.	Equipment maintained.	Hensley/Castillo/ M, EA, CR, and FE teams	Necessary equipment of STX/STT available for rapid processing of water samples taken from either island.
WL1.2b: Scout locations for sampling and collect permits.	Locations of interest geo-tagged for permitting processes.	Yearly reporting requirements fulfilled.	Yearly reporting requirements fulfilled.	Yearly reporting requirements fulfilled.	Yearly reporting requirements fulfilled.	Hensley/Waddell/ M, EA, CR, and FE teams	Sites identified that are both practicable (physical access) and scientifically applicable with stable legal access.
WL1.2c: Collect and process water samples.	Samples collected (approx. 48 total) and processed regularly and after runoff events (4 per year, est.).	Samples collected (approx. 48 total) and processed regularly and after runoff events (4 per year, est.).	Samples collected (approx. 48 total) and processed regularly and after runoff events (4 per year, est.).	Samples collected (approx. 48 total) and processed regularly and after runoff events (4 per year, est.).	Samples collected (approx. 48 total) and processed regularly and after runoff events (4 per year, est.).	Hensley/Castillo/ Students/M, EA, CR, and FE teams	Characterization of nutrient and bacteriological fluxes into marine environment in two VI watersheds.
WL1.2d: Interface with other teams for sample collection.	Raw data received + quarterly check-in.	Raw data received + quarterly check-in.	Raw data received + quarterly check-in.	Raw data received + quarterly check-in.	Raw data received + quarterly check-in.	Hensley/M, EA, CR, and FE teams	Maintains links with other research teams involved in water sample collection.

WL1.2e: Interpret data and determine conclusions for dissemination in community and scientific literature.	Reporting requirements fulfilled (1 annual report produced), results disseminated at conference and abstract produced (see WL3.3a and WL3.3b)	Reporting requirements fulfilled (1 annual report produced), results disseminated at conference and abstract produced (see WL3.3a and WL3.3b)	Reporting requirements fulfilled (1 annual report produced), results disseminated at conference and abstract produced (see WL3.3a and WL3.3b)	Reporting requirements fulfilled (1 annual report produced), results disseminated at conference and abstract produced (see WL3.3a and WL3.3b)	Data interpreted to make conclusions with recommendations for final report	Hensley/M, EA, CR, and FE teams	Nutrient and bacteriological flux into the watershed characterized for policy decisions, stakeholders, scientific community, and public education.
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 production systems for nutrient cycling, water infiltration, and sediment flux compared to reference forests. · 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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
WL2.1a: Design/ establishment.	Secure agreements with landowners, install monitoring equipment.	Equipment maintenance.	Conservation practices implemented at project mid-point (intervention).	Equipment maintenance.	Equipment maintenance.	Hensley/Students	Location and set-up of long term monitoring sites with necessary permissions/ participation for land use conservation interventions; demonstration sites active by Year 3 for education purposes.

WL21.b: Sample collection.	Random + post rainfall samplings (total 8 per year).	Random + post rainfall samplings (total 8 per year).	Random + post rainfall samplings (total 8 per year).	Random + post rainfall samplings (total 8 per year).	Random + post rainfall samplings (total 8 per year).	Hensley/Postdoc/ Students	Randomized and rainfall-response samplings carried out to fully characterize both wet and dry period impacts downstream of upland land use practices.
WL2.1c: Sample processing.	Soil samples (approx. 40) processed by lab.	Soil samples (approx. 40) processed by lab.	Soil samples (approx. 40) processed by lab.	Soil samples (approx. 40) processed by lab.	Soil samples (approx. 40) processed by lab.	Hensley/Students	Soil samples submitted for lab analysis of nutrient flux from land use types with and without intervention.
WL2.1d: Data analysis.	Analysis for reporting reqs.	Analysis for reporting reqs.	Analysis for reporting reqs.	Analysis for reporting reqs.	Final analysis.	Hensley/Postdoc	Provides ongoing conclusions for public relations/ education and final conclusions for presentation to scientific community.

Objective WL2.2	Specific milestones. Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
WL2.2a: Design/ establishment.	Secure agreements with landowners and relevant agencies, install monitoring equipment.	Equipment maintenance, orchard maintenance.	Equipment maintenance, orchard maintenance.	Equipment maintenance, orchard maintenance.	Equipment maintenance, orchard maintenance.	Hensley/Waddell/ Students	Location and set-up of long term agroforestry orchard establishment compared to forest with necessary permissions/ participation; comparison of land use types serves as educational tool.
WL2.2b: Sample collection.	Samples collected from all fields (8 total fields).	Samples collected from all fields (8 total fields).	Samples collected from all fields (8 total fields).	Samples collected from all fields (8 total fields).	Samples collected from all fields (8 total fields).	Hensley/Postdoc/ Students	Randomized-schedule soil samplings carried out to characterize agroforestry and reference forest soil systems, water infiltrometer carried out over project life.
WL2.2c: Sample processing.	Soil samples processed by lab (approx. 32)	Soil samples processed by lab (approx. 32)	Soil samples processed by lab (approx. 32)	Soil samples processed by lab (approx. 32)	Soil samples processed by lab (approx. 32)	Hensley/ Students.	Soil samples submitted for lab analysis in same manner as Objective WT2.1.

WL2.2d: Data analysis.	Analysis for reporting reqs.	Analysis for reporting reqs.	Analysis for reporting reqs.	Analysis for reporting reqs.	Final analysis.	Hensley/Postdoc	Provides ongoing conclusions for public relations/ education and final conclusions for presentation to scientific community.
	Specific milestones						
Objective WL2.3	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
WL2.3a: Design/ establishment.	Plantain planting and living mulch establishment.	Plantain maintenance.	Plantain maintenance.	Plantain maintenance.	Completed.	Hensley/Students	Plot-scale studies of living mulch used within plantain system as related to soil moisture, infiltration, and nutrient cycling.
WL2.3b: Sample collection.	Samples collected from all plots (16 plots).	Samples collected from all plots (16 plots).	Samples collected from all plots (16 plots).	Samples collected from all plots (16 plots).	Completed.	Hensley/Postdoc/ Students	Rigorous, causative and mechanistic results related to specific hypothesis stemming from larger goal work (objs. 1a & 1b).
WL2.3c: Sample processing.	Soil samples processed by lab (approx. 96).	Soil samples processed by lab (approx. 96).	Soil samples processed by lab (approx. 96).	Soil samples processed by lab (approx. 96).	Completed.	Hensley/Students	Soil samples submitted for lab analysis in same manner as Objective WT2.1.

WL2.3d: Data analysis.	Analysis for reporting reqs.	Analysis for reporting reqs.	Analysis for reporting reqs.	Final analysis.	Completed.	Hensley/Postdoc	Provides ongoing conclusions for public relations/ education and final conclusions for presentation to scientific community.
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.							
	Specific milestones						
Objective WL3.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
WL3.1a: Participate in service-learning/ mentoring of SCI-100 and R2R Resilience Leaders students.		Engage and mentor 1 SL/ SCI-100/ Resilience leader student.	Engage and mentor 1 SL/ SCI-100/ Resilience leader student.	Engage and mentor 1 SL/ SCI-100/ Resilience leader student.	Engage and mentor 1 SL/ SCI-100/ Resilience leader student.	Hensley	Four students mentored in engagement program, possibly for higher levels of engagement further into project duration.
WL3.1b: Contribution to R2R newsletter.	Photographs of project and essay produced.	Photographs of project and essay produced.	Photographs of project and essay produced.	Photographs of project and essay produced.	Photographs of project and essay produced.	Hensley	Articles relating Watershed/ Terrestrial research activities with current needs of R2R project messaging.
WL3.1c: Creation of lectures and presentations for EOD events.	One presentation or lecture at a sponsored event.	One presentation or lecture at a sponsored event.	One presentation or lecture at a sponsored event.	One presentation or lecture at a sponsored event.	One presentation or lecture at a sponsored event.	Hensley	Lectures, presentations, and attendance of outreach events.

WL3.2a: Participation of undergraduate students in research activities	Engagement of 1 undergraduate in paid participation.	Engagement of 1 undergraduate in paid participation.	Engagement of 1 undergraduate in paid participation.	Engagement of 1 undergraduate in paid participation.		Hensley/Students	At least one (up to 4) undergraduate students directly involved in watershed research activities.
WL3.2b: Participation of graduate students in research activities.		Engagement of 1 graduate student in paid participation.	Engagement of 1 graduate student in paid participation.	Engagement of 1 graduate student in paid participation.	Engagement of 1 graduate student in paid participation.	Hensley/Students	At least one (up to 4) graduate students directly involved in watershed research activities.
	Specific milestones						
Objective WL3.3	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
WL3.3a: Attendance and presentation at scientific conferences.	Attendance/ present at one conference.	Attendance/ present at one conference.	Attendance/ present at one conference.	Attendance/ present at one conference.	Attendance/ present at one conference.	Hensley/Postdoc/ Students	Results compiled and presented at one conference per year for engagement with interested scientific community.
WL3.3b: Publication of results in peer reviewed literature.	Preliminary abstract completed for all research projects.	Preliminary abstract completed for all research projects.	Preliminary abstract completed for all research projects.	Compilation of results into manuscript form, at least one manuscript resulting from Goal WL1, and a manuscript each from Objectives WL2.1, WL2.2, and WL2.3.	Manuscripts drafted and submitted to peer-reviewed journals at the end of the study period.	Hensley/Postdoc/ Students	Communication of results and conclusions with scientific community; finalization of scientific conclusions for use in future projects or grants.

Mangroves and Mangrove Restoration

The goal of the mangrove ecosystem function and recovery Team is to study the current and historic distribution, loss and recovery of the different mangrove species in the territory using a mix of archival maps and new technologies. The goal of the Mangrove Restoration activities is to develop science-based opportunities for restoration by field testing restoration techniques and the factors that influence seedling success and resilience.

These two research areas have a common goal to share USVI mangrove research with stakeholders and provide opportunities for training and new partnerships. To achieve this goal, we will share mangrove research through integration activities (planned Informal Learning (IL) and EWFD activities, community events, and other opportunities), provide opportunities for student training and enrichment, and participate in professional development opportunities that boost communication of research and strengthen partnerships.

Goal M1

Investigate current and historic USVI mangrove distribution, recovery, and loss. Understanding how the recovery (or lack of recovery) of mangrove ecosystems is affecting the provision of key ecosystem services such as trapping land-based nutrients and sediments, can inform management and conservation practices for mangrove forests in the Territory.The team will document historical and current mangrove extent and estimated species composition across the territory using archival information and the application of new technology. They will also document the current status and recovery of mangroves using aerial imagery and long-term field plots.

Goal M2

Grow USVI Mangrove Restoration Opportunities. The Territory has lost over 50% of its historic mangrove forests, and understanding the historical distribution and the abiotic and biotic factors that influence seedling success, there is an opportunity to identify suitable sites for restoration that could improve the function of coastal ecosystems and their ecosystem services. Such an effort could enhance coastal ecosystem resilience. The team will examine where and how mangrove restoration can be implemented in the USVI, and field test different mangrove restoration techniques to understand factors affecting resilience of seedlings.

Goal M3

Share USVI Mangrove Research with Stakeholders & Provide Opportunities for New Partnerships. By using mangrove restoration activities as a chance to engage the broader VI community in STEM research, these activities will increase individuals' understanding of coastal wetlands systems as a result of their participation. Given the Territory's demographics, the R2R team can explore the motivation for participation of these underrepresented minorities and the potential for increasing citizen science activities in the Territory. The team will grow the mangrove citizen science program and then evaluate the impacts of the mangrove citizen science program.

The impacts for the Mangrove and Mangrove Restoration areas include a new understanding of the historical and current distribution and status of USVI mangroves, growth of USVI mangrove restoration opportunities, including creation and evaluation of a citizen science program and mangroves restoration science, and new training opportunities for 2-10 undergraduate students and up to 4 graduate students at the University of the Virgin Islands.

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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	Compilation completed.				Grimes, Durdall	Contributes to analysis of current mangrove distribution and mangrove loss.

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.	Compilation completed.				Grimes, Durdall	Contributes to analysis of current mangrove distribution and mangrove loss.
M1.1c: Take new drone imagery of mangroves across the territory, as able and permitted.	Identification of priority USVI mangrove sites for drone imagery collection. Team becomes acquainted with drone flight operation & imagery processing software. Imagery collection begins.	Drone flights completed over territorial mangroves for high resolution imagery of current mangrove extent. Images georeferenced and organized into Geodatabase.				Grimes, Durdall, graduate student	Contributes to analysis of current mangrove distribution and mangrove loss.

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.	Completion of atlas of mangrove historical and current extent, with estimation of species composition areas, where possible.				Grimes, Durdall	Map of current mangrove distribution and analysis of historic mangrove loss.
M1.1e: Atlas and historical narrative shared.			Summary document written; detailed report of atlas tool and key takeaway findings shared with stakeholders.			Grimes, Durdall	Written summation of mangrove atlas shared with stakeholders.
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes

M1.2a: Site selection.	Finalization of research sites (2), in coordination with other R2R research areas.					Grimes, Durdall	Sites chosen for long-term monitoring.
M1.2b: Apply for permits.	Applicable territorial and federal permits drafted, submitted, and approved (up to 3).					Grimes, Durdall	Permits acquired.
M1.2c: Conduct repeat drone surveys of sites, where permitted.	Drone surveys completed (2x per year)	Drone surveys completed (2x per year)	Drone surveys completed (2x per year)	Drone surveys completed (2x per year)	Drone survey completed (1 in final year)	Grimes, Durdall	Contributes to mangrove atlas as well as long-term monitoring site recovery mapping.
M1.2d: Document areas of existing canopy extent, damage, and dead trees at study sites.	Determined drone survey methods suitability; if suitable, aerial imagery georeferenced, mapping completed for that year's imagery. If not, ground survey methods completed.	Completed re-surveys	Completed re-surveys	Completed re-surveys	Completed re-surveys	Grimes, Durdall, graduate student	Contributes to long-term monitoring site recovery mapping.

M1.2e: Analyze mapping data to estimate percent mortality and percent recovery.	Completed analysis of year 1 data.	Completed analysis of year 2 data, including change over time analysis of years 1-2.	Completed analysis of year 3 data, including change over time analysis of years 1-3.	Completed analysis of year 4 data, including change over time analysis of years 1-4.	Completed analysis of year 5 data, including change over time analysis of years 1-5.	Grimes, Durdall, graduate student	Map of mangrove recovery and loss at research sites.
M1.2f: Assess new mangrove growth baseline.	Rapid assessment methods for new mangrove growth developed; completed at main study sites and potentially additional sites across the territory.					Grimes, graduate student, Durdall	Rapid assessment of new growth completed.
M1.2g: Establish and re-survey long term mangrove plots within research sites.	Long-term monitoring methods developed using USGS methods, plot locations determined and surveyed.	Completed re-survey of long-term plots.	Completed re-survey of long-term plots.	Completed re-survey of long-term plots.	Completed re-survey of long-term plots.	Grimes, Durdall, graduate student	Long-term mangrove dataset created for research sites.
M1.2h: Analyze long-term monitoring plot data.	Completed analysis of year 1 data.	Completed analysis of year 2 data, including change over time analysis of years 1-2.	Completed analysis of year 3 data, including change over time analysis of years 1-3.	Completed analysis of year 4 data, including change over time analysis of years 1-4.	Completed analysis of year 5 data, including change over time analysis of years 1-5.	Grimes, Durdall, graduate student	Investigation of the status and recovery of mangroves at long-term sampling sites.

M1.2i: Analyze cores for carbon storage.	Up to 6 sediment cores collected at long-term monitoring sites. Completed laboratory analysis of cores for organic matter (OM) as a proxy for carbon content. Initial analysis of year 1 cores completed.	Repeated collection of sediment cores at long-term monitoring sites. Completed laboratory analysis of cores for OM. Analysis of year 2 cores completed, including comparisons to carbon storage from prior year.	Repeated collection of sediment cores at long-term monitoring sites. Completed laboratory analysis of cores for OM. Analysis of year 3 cores completed, including comparisons to carbon storage from prior year.	Repeated collection of sediment cores at long-term monitoring sites. Completed laboratory analysis of cores for OM. Analysis of year 4 cores completed, including comparisons to carbon storage from prior year.	Repeated collection of sediment cores at long-term monitoring sites. Completed laboratory analysis of cores for OM. Analysis of year 5 cores completed, including comparisons to carbon storage from prior year.	Grimes, Durdall, graduate student	Contributes to investigation of the status and recovery of mangroves at long-term sampling sites.
M1.2j: Share long-term monitoring results.					Peer-reviewed publication submitted or management document created and shared with stakeholders.	Grimes, Durdall, graduate student	Written summation of long-term monitoring results shared.
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
M2.1a: Apply for mangrove propagule collection permits.	Applicable territorial and federal permits drafted, submitted, and approved (up to 3).					Grimes, Durdall	Permits acquired.
M2.1b: Prepare, develop, and maintain a mangrove nursery.	Mangrove nursery methods researched. Materials and supplies needed for establishment of nursery infrastructure, acquired. Nursery established.	Nursery maintained and fine-tuned.	Nursery maintained and fine-tuned.	Nursery maintained and fine-tuned.	Nursery maintained and fine-tuned.	Grimes, Durdall, graduate student	Establishment of mangrove nursery.

M2.1c: Collect mangrove propagules for nursery stocking.	At least 2 propagule collection sites identified. Propagule tracking/tagging methodology established. Mangrove nursery database established. Initial propagules collected, tagged, added to the database and transferred to the nursery.	Collection of additional propagules as needed for nursery grow-out and outplanting experiments.	Collection of additional propagules as needed for nursery grow-out and outplanting experiments.	Collection of additional propagules as needed for nursery grow-out and outplanting experiments.	Collection of additional propagules as needed for nursery grow-out and outplanting experiments.	Grimes, Durdall, graduate student	Propagules acquired for grow-out experiments and citizen science program. System established for propagule/sapling tracking.
M2.1d: Conduct water-table and field grow-out experiments.	Established experimental design for water-table and field grow out experiments for mangrove seedlings. Experiments initiated and maintained. Results added to mangrove nursery database.	Experiments completed. Results added to mangrove nursery database. Nursery stocking techniques refined based on results.	Additional experiments planned, if needed, based on results of previous years.	Additional experiments planned, if needed, based on results of previous years.	Additional experiments planned, if needed, based on results of previous years.	Grimes, Durdall, graduate student	Best practices documented and established for mangrove water-table nursery and field grow-out.

M2.1e: Analyze mangrove nursery grow-out experiment results.	Analysis of year 1 nursery data initiated.	Analysis of years 1-2 nursery data completed.				Grimes, graduate student	Investigation of water-table and grow-out experiment results. Contributes to creation of mangrove propagule nursery best-practices.
M2.1f: Mangrove nursery grow-out methods, best practices, and results shared.		1 graduate student thesis	1-peer-reviewed publication submitted. Results shared with stakeholders.			Grimes, Durdall, graduate student	Written summary of best practices is created and shared with stakeholders.
Objective M2.2 Field test different mangrove restoration techniques to understand factors affecting resilience of seedlings.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes

M2.2a: Determine mangrove restoration sites.			Used the territorial mangrove atlas (M1), and other existing local mangrove data to determine a list of candidate sites for mangrove restoration. Candidate sites ranked for restoration potential, and final sites chosen.			Grimes, Durdall, graduate student	List of candidate mangrove restoration sites in the territory.
M2.2b: Apply for mangrove outplanting permits.			Applicable territorial and federal permits drafted, submitted, and approved (up to 3).			Grimes, Durdall, graduate student	Permits obtained.
M2.2c: Conduct restoration experiments to investigate effects of spacing and bioturbator abundance on seedling resilience.			Experimental design determined. Experiments initiated (seedlings outplanted & regularly monitored and assessed).	Experiments completed.		Grimes, Durdall, graduate student	Contributes to mangrove restoration experiment publication.
M2.2d: Analysis of restoration experimental data.			Analysis of year 3 outplant data initiated.	Analysis of years 3-4 nursery data completed.		Grimes, graduate student	Contributes to mangrove restoration experiment publication.

M2.2e: Mangrove restoration experimental outcomes shared.				1 graduate student thesis	1-peer-reviewed publication submitted	Grimes, graduate student	Peer-reviewed publication. Mangrove restoration best-practices identified.
Objective M2.3 Grow the mangrove citizen science program.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
M2.3a: Coordinate with existing partners and seek new partnership opportunities to support program development	Meet with at least 2 partners to discuss program goals and strategies					Grimes, Durdall, partners	Collective understanding of program goals and plan among research team and partners.
M2.3b: Recruit program participants.	Develop recruitment materials. Advertise and begin participant recruitment	Recruit participants	Recruit participants	Recruit participants	Recruit participants	Grimes, Durdall, partners	Citizen science participants recruited and involved in mangrove nursery operations.
M2.3c: Engage participants in mangrove restoration activities.		Engage participants in mangrove grow-out activities.	Engage participants in mangrove grow-out activities; engage participants in restoration experiments.	Engage participants in mangrove grow-out activities; engage participants in restoration experiments.	Engage participants in mangrove grow-out activities.	Grimes, Durdall, partners	Citizen science participants recruited and involved in mangrove nursery operations and field experiments.

Objective M2.4 Evaluate the impacts of the mangrove citizen science program.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
M2.4a: Obtain UVI IRB approval.		Apply for and obtain IRB approval.				Grimes, Peterman	IRB approval.
M2.4b: Develop and test assessment instruments.		Existing instruments tested for cultural relevance; embedded assessment activities identified and/or created				Grimes, Peterman	Culturally-appropriate evaluation instruments developed and used.
M2.4c: Collect participant data.			Collect demographic, engagement and pre-post outcomes data on participants; conduct interviews with sub-set of participants on motivation and stewardship.	Collect demographic, engagement and pre-post outcomes data on participants; conduct interviews with sub-set of participants on motivation and stewardship.	Collect demographic, engagement and pre-post outcomes data on participants; conduct interviews with sub-set of participants on motivation and stewardship.	Grimes, Durdall, Peterman	Mangrove citizen science program described: who participates and why they do.
M2.4d: Analyze participant data.			Year 3 participant data analyzed.	Year 4 participant data analyzed.	Year 5 participant data analyzed; 3-year temporal analysis completed.	Grimes, Peterman	Mangrove citizen science program described: who participates and why they do.

M2.4e: Communicate and build on research findings.					Peer-review publication of citizen science program submitted.	Grimes, Peterman	1 peer-reviewed publication submitted.
Goal M3: Share USVI Mangrove Research with Stakeholders & Provide Opportunities for Training and 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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
M3.1a: Integration Activity: Share research through VI EPSCoR channels (Promotions, announcements & blog posts).	Contribute to 2 products or events per year.	Contribute to 2 products or events per year.	Contribute to 2 products or events per year.	Contribute to 2 products or events per year.	Contribute to 2 products or events per year.	Grimes, Durdall, graduate students, undergraduate students	Mangrove research shared with a broad audience.
M3.1b Share research through community outreach events (e.g., Reef Fest, Sip N' Science)	Participate in 1 event per year	Participate in 1 event per year	Participate in 1 event per year	Participate in 1 event per year	Participate in 1 event per year	Grimes, Durdall, graduate students, undergraduate students	Mangrove activities shared with local audiences.

M3.1c: Integration Activity: Participate in VI-ISERP activities.		Participate in summer institute	Mentor subset of cohort 1 teachers (n = 8); Participate in summer institute	Mentor subset of cohort 2 teachers (n = 7)		Grimes, Durdall, graduate students, undergraduate students	USVI teacher professional development, potential student professional development.
M3.1d: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website					Grimes	EPSCoR Website developed.
M3.1e: Integration Activity: EPSCoR Newsletter	Contribute material to Spring newsletter	Contribute material to Fall and Spring Newsletters	Contribute material to Fall and Spring Newsletters	Contribute material to Fall and Spring Newsletters	Contribute material to Fall and Spring Newsletters	Grimes, Durdall, graduate students, undergraduate students	EPSCoR Newsletter developed.
Objective M3.2 Provide opportunities for student training and enrichment.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
M3.2a: Engage undergraduate students in mangrove research.	2 undergraduates engaged in mangrove research.	2 undergraduates engaged in mangrove research.	2 undergraduates engaged in mangrove research.	2 undergraduates engaged in mangrove research.	2 undergraduates engaged in mangrove research.	Grimes	2-10 undergraduates engaged in the geosciences.
M3.2b: Engage graduate students in mangrove research.	2 graduate students engaged in mangrove research.	2 graduate students engaged in mangrove research.	2 graduate students engaged in mangrove research.	2 graduate students engaged in mangrove research.		Grimes	4 graduate students engaged in the geosciences.

Objective M3.3 Participate in professional development opportunities that boost communication of research and strengthen partnerships.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
M3.3a: Participate in R2R writing workshops, as scheduled.		Participate in 1 workshop	Participate in 1 workshop	Participate in 1 workshop		Grimes, Durdall	New partnerships formed, grant proposals, and/or publications drafted and submitted.
M3.3b: Attend and share research efforts at local, national and international conferences.	Participate in 1 conference per year.	Participate in 1 conference per year.	Participate in 1 conference per year.	Participate in 1 conference per year.	Participate in 1 conference per year.	Grimes, Durdall, graduate students	Dissemination of data to the community. Strengthening of partnerships and research opportunities.
M3.3c: Integration Activity: Attend annual VI EPSCoR Conference.		Participate in VI-EPSCoR annual conference.	Participate in VI-EPSCoR annual conference.	Participate in VI-EPSCoR annual conference.	Participate in VI-EPSCoR annual conference.	Grimes, Durdall, graduate students	Dissemination of data to the R2R team. Strengthening of partnerships and research opportunities.

Emerging Areas of Research

The goal of the Emerging Areas of Research Team is to improve understanding of the variables that influence coastal and nearshore ecosystem function and resilience. Emerging areas of research in the R2R project include three integrated areas of focus, but centered on seagrass communities in the shallow waters off of USVI beaches. The interest in seagrasses as part of our exploration of 'Ridge to Reef' dynamics is, in part, due to their provision of important ecosystem services reducing coastal erosion, enhancing water clarity, capturing pollutants and carbon, as nursery habitats for economically important fish, and as food for marine vertebrates and invertebrates including endangered sea turtles, and moderating wave heights and storing sediments. They are also recognized for reducing shoreline erosion and facilitating recovery of beaches after modest storms.

A recent (since 2011) variable influencing coastal and nearshore ecosystem function has been the large influxes and accumulation of pelagic brown algae in the genus *Sargassum* onto shorelines. The change in the amount of algae affecting shores has been linked to economic losses from decreased fisheries and tourism, die-offs of marine life, and even health hazards to humans exposed to these accumulations.

Goal EA1

Determine the impacts of invasive seagrass that may alter movement, habitat, and food resources for invertebrates, fish, sea turtle species. Understanding the role of habitat quality and habitat use in the movement ecology of large vertebrate species, including endangered species such as sea turtles, will inform their management and protection. Furthermore, such research is popular with K-12 students and the public, consequently informal learning opportunities with the public are well attended and impactful. The team will install an acoustic positioning system to monitor the movement of tagged macrofauna (sea turtles, fish, and conch) in areas of changing seagrass communities.

Goal EA2

Quantify the role of seagrass type in short and long-term beach evolution. By increasing understanding of the role of seagrass in moderating wave heights, storing sediments, reducing shoreline erosion, and enhancing beach recovery, the research outputs can contribute to the improved monitoring and management of seagrass meadows, and in turn, increase beach and nearshore ecosystem resilience. The team will quantify wave and water column velocities characteristics and difference between two species of seagrass under different conditions. They will also quantify sediment movement and shoreline evolution under different wave conditions, shoreward of different types of seagrass beds.

Goal EA3

Measure the spread of the invasive seagrass Halophila stipulacea *in the territory and the mechanisms affecting its expansion.* Given that little is known about the biology, physiology or phenology of the invasive seagrass, increasing our understanding will lead to improved control and management of the species, as well as its effects on the faunal distribution in nearshore environments. The Team will measure the distribution and expansion rate of the invasive seagrass as well as explore the physiological tolerance of the invasive seagrass to environmental variation, and the role of herbivores as top-down control of *H. stipulacea*.

Goal EA4

Analyze the effects of Sargassum *golden tides on Virgin Islands ecosystems.* The recent change in the increased amounts of the algae have had significant impacts on the coastal tourism and fishing economies from Belize and Mexico to the southern islands in the Lesser Antilles. However, the ecology of the *Sargassum* species is not well known. The Team has an opportunity to determine potential mitigation strategies to reduce the impacts of this algae on island ecosystems and indirectly, their economies. The Team will determine the genetic diversity of golden tides, and measure the effects of *Sargassum* accumulations on beach biota and on water quality as the algae decomposes.

The impact of the Emerging Areas of Research is the improved understanding of the physical variables that influence coastal and nearshore ecosystem function and resilience, including the role of seagrasses and impacts of the brown algae *Sargassum*.

Emerging Areas: Brewers VPS Array, Beaches, Seagrass, Sargassum (EA)							
Goal EA 1. Determine the impacts of invasive seagrass that may alter movement, habitat, and food resources for invertebrates, fish, sea turtle species. · Objective EA 1.1: Install Vemco (Innovasea) Acoustic positioning system to monitor the movement of tagged macrofauna (sea turtles, fish, and conch) in areas of changing seagrass communities. · Objective EA 1.2: Deploy acoustic tags on sea turtles, fish and conch utilizing these areas susceptible to changes in seagrass communities 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 a verbal agreements with Dr. K. Hart (USGS) for this project to be added to her current NMFS and local permits.							
	Specific milestones						
Objective EA1.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
EA1.1a: Obtain permitting and equipment required for tagging sea turtles and fish.	Receive ten year NMFS permit, two year local permit, and equipment orders received.	Annual NMFS and DPNR permit report completed.	Annual NMFS and DPNR permit report completed. Renew Local DPNR permit.	Annual NMFS and DPNR permit report completed.	Annual NMFS and DPNR permit report completed.	Paul Jobsis and two students	With the permit in place sea turtle, fish and conch movement tracking will occur and allow outreach and education events.
EA1.1b: Install acoustic receivers, Hobo temp loggers, DO2 Loggers.	Design and order additional Vemco (Innovasea) receivers, tags and batteries	Vemco position system array installed. Download acoustic data and analyze every four months.	Vemco position system array maintained (battery replacement). Download acoustic data and analyze every four months.	Decommission VPS Acoustic Array, or maintain using other funding sources.	Decommission VPS Acoustic Array, or maintain using other funding sources.	Paul Jobsis (initially); post-doctoral fellow, and 2 graduate students	Collection of a high precision movement dataset that will help determine the effect of changing seagrass communities.

EA1.1c: Acoustic tracking student and postdoc engagement for turtle and fish tracking in changing seagrass beds, and sargassum events.	Attract and enroll a minimum of three students interested in invasive seagrass, movement ecology and acoustic tracking. Advertise for one acoustic tracking / movement ecology post-doctoral fellow	Post doctoral fellow hired, and 2 Masters and 2 undergraduate students engaged in Brewers Bay animal tracking project	Post doctoral fellow fully engaged, 2 master and 2 undergraduate students working on Brewers Bay animal tracking project Screen reader support enabled.	Test the hypothesis that turtles and other macro-fauna avoid H. stipulacea seagrass beds and prefer (spend more time) in native *S. filiforme* and *T. testudinum.*	Develop and publish theses results related to bethnic habitat, invasive seagrass and sea turtle, fish and macroinvertebrate movement	Paul Jobsis and Richard Nemeth. Once hired post doctoral fellow will coordinate tagging, array maintenance and data management	2 MMES students graduating with movement ecology based theses. 2 or more conference presentations, 1 or more movement ecology peer-review publications
EA1.1d: Dropcam and sample seagrass beds quaterlyrandomly sampled in 100cm2 subplots quarterly		Randomly sample 3 seagrass type beds within the array and use DropCam to characterize benthic habitat within the VPS array biannually.	Randomly sampled 3 seagrass type beds within the array and use DropCam to characterize benthic habitat within the VPS array biannually.	Test the hypothesis that turtles and other macro-fuana avoid *H. stipulacea* seagrass beds and prefer (spend more time) in native *S. filiforme* and *T. testudinum.*		Paul Jobsis, post-doctoral fellow and students	Bethic habitat map that shows the changing seagrass connected communites
EA1.1e: Brewers Bay Water quality sampling.	Collect water samples quarterly and test for standard water quality and nutrients.	Collect water samples bi-monthy (6/yr) and conduct standard water quality and nutrient analysis.	Collect water samples bi-monthy (6/yr) and conduct standard water quality and nutrient analysis.	Collect water samples bi-monthy (6/yr) and conduct standard water quality and nutrient analysis.		Paul Jobsis, AmberPackard (EAL), and two students: synergistic with ongoing ambient monitoring project	Water quality dataset from Brewers Bay during movement and seagrass study

EA1.1f: Outreach and Education.	1 VI-EPSCoR blog post and one local media article	One public sea turtle tagging event, and VI-ISERP particiaption	One public sea turtle tagging event, and VI-ISERP particiaption	1 public sea turtle tagging event, VI-ISERP participation and 1 local publication	VI-ISERP participation, VI-EPSCoR blog post, and local paper article	Paul Jobsis, two masters and two undergraduate students	Four educational outreach events through VI-ISERP and three local paper publications, two VI-EPSCoR blog posts and two public sea turtle outreach events.
Objective EA 1.2			Specific milestones				
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
EA 1.2a: Acoustically tag sea turtles and fish.	Recruit at least two masters students interested in movement ecology and acoustic tracking project in Brewers Bay	Place acoustic tags on 8 to 12 of each species to be tracked, engage and hire two undergraduate students interested in acoustic tracking.	Continue tagging if needed.	Analyze VPS array data by Vemco. Develop two theses and manuscripts for publication.	Manuscript development and publication of two peer-reviewed articles	Paul Jobsis' students and postdoc	Publish results of movement study and mark and recapture studies in years four and five.
EA 1.2a: Tag sea turtles and fish (non-acoustic tags) for mark and recapture population estimates.	Recruit at least two masters students interested in movement ecology and acoustic tracking project in Brewers Bay.	Turtle and fish tagging (non acoustic) every four months to estimate population size in the affected areas.	Turtle and fish tagging (non acoustic) every four months to estimate population size in the affected areas.	Turtle and fish tagging (non acoustic) every four months Turtle and fish tagging (non acoustic) every four months to estimate population size in the affected areas, thesis development.	Manuscript development and publication of two peer-reviewed articles	Paul Jobsis' students and postdoc	Estimate population size annually.

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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
Activity EA 2.1a: Explore selected sites and acquire equipment and obtain permit(s).	Permits received for instruments and site.	Permits received/ renewed for instruments and site(s).	Permits received/ renewed for instruments and site(s).	Permits received/ renewed for instruments and site(s).	Permits received/ renewed for instruments and site(s).	Greg Guannel, Edwin Cruz-Rivera	Authorized to work in the field.
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; identify new graduate student for following year as appropriate; recruit undergraduate student.	Graduate student identified and recruited; identify new graduate student for following year as appropriate; recruit undergraduate student.	Graduate student identified and recruited; identify new graduate student for following year as appropriate; recruit undergraduate student.	Graduate student identified and recruited; identify new graduate student for following year as appropriate; recruit undergraduate student.	Greg Guannel, Edwin Cruz-Rivera, Kristin Wilson-Grimes	Graduate and undergraduate students are working on the project and learning new skills.

EA2.1c: Seagrass bed characteristics.		Measure physical characteristics of seagrass beds (density, stem diameter, stem height) for the two species in order to include them appropriately into hydrodynamic models (see subactivities below).	Monitor any changes in seagrass characteristics from Year 2.	Monitor any changes in seagrass characteristics from Year 2.	Monitor any changes in seagrass characteristics from Year 2.	Greg Guannel, Edwin Cruz-Rivera, Graduate student	Physical characteristics of seagrass meadow.
EA2.1d: Wave measurement and analysis.	Deploy and test wave buoys and pressure transducers for training of the students and wave model calibration.	Measure wave attenuation caused by seagrass meadows, using characteristics measures in previous activity; first estimate of hydrodynamic characteristics by calibrating wave model	Refinement of Year 2 hydrodynamics characteristics of the seagrass beds based on more data collected over longer period of time	Characterize how seagrass meadow(s) affect wave evolution; prepare and submit publication.	Focus on following activities.	Greg Guannel, Edwin Cruz-Rivera, Graduate student	Understanding of how seagrass type affect wave evolution; understanding of the uncertainties associated with the calculation of drag coefficient based on location of wave measurements, seagrass meadow characteristics, and offshore wave conditions.

EA2.1e: Wave-induced current measurement and analysis.			Deploy and test instruments with velocity profilers	Characterize velocity profile over meadows; characterize how meadows modify currents using calibrated hydrodynamic models.	Using results obtained in this and the previous activity (EA2 1d and 1e), prepare publication on how meadows change current profiles under different wave conditions, and implications for sediment transport. Prepare proposal to do same type of analyses on top of reefs.	Greg Guannel, Edwin Cruz-Rivera, Graduate student	Understanding of how seagrass type affect wave evolution and wave-induced current; understanding of the uncertainties in the proper modeling of wave and wave-induced current associated with the calculation of drag coefficient based on location of wave measurements, seagrass meadow characteristics, and offshore wave conditions.
Activity EA2.1f: Align with Objective 1.2b					Relate beach response to sedimentation on seagrass beds, wave and wave-induced currents evolution on seagrass bed.	Greg Guannel, Edwin Cruz-Rivera, Graduate student	Role of seagrass on beach response.
	Specific milestones						
Objective EA 2.2	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
EA 2.2a: Identify site(s), acquire equipment and obtain permits(s).	Permits received for instruments and site.	Permits received/ renewed for instruments and site(s).	Permits received/ renewed for instruments and site(s).	Permits received/ renewed for instruments and site(s).	Permits received/ renewed for instruments and site(s).	Greg Guannel, Edwin Cruz-Rivera	Authorized to work in the field.

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; identify new graduate student for following year as appropriate; recruit undergraduate student.	Graduate student identified and recruited; identify new graduate student for following year as appropriate; recruit undergraduate student.	Graduate student identified and recruited; identify new graduate student for following year as appropriate; recruit undergraduate student.	Graduate student identified and recruited; identify new graduate student for following year as appropriate; recruit undergraduate student	Greg Guannel, Paul Jobsis, Kristin Wilson-Grimes	Graduate and undergraduate students are working on the project and learning new skills
EA 2.2c: Sedimentation on seagrass beds.		Install sediment rods on seagrass meadows (two species) and outside the meadow to monitor sedimentation rates; get familiar with sedimentation monitoring and results reporting.	Continue to monitor sedimentation inside and outside of seagrass meadows; compare sedimentation rates to observed wave climate from Objective 1.2a.	Relate qualitatively wave and sedimentation.		Greg Guannel	Relationship between wave environment and sedimentation on seagrass.

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.	Regularly survey beach and bathymetry.	Regularly survey beach and bathymetry, ensure that observed changes match results from sediment rods measurements; relate qualitatively observed changes in sedimentation above and underwater with offshore and nearshore wave characteristics.	Relate qualitatively wave and sedimentation and beach response; use bathymetry measured in calibrated wave model from Activity 1.2a appropriately to evaluate sensitivity of hydrodynamic model to input conditions; continue beach and bathymetric surveys.	Establish relative role of seagrass meadows in controlling cross-shore sediment movement and beach response to wave forcing; establish the sensitivity and the uncertainty associated with modeling the role of seagrass in wave evolution, wave-induced currents and beach response. Prepare publication.	Greg Guannel, Edwin Cruz-Rivera, Graduate student, Undergraduate students	Understanding of seagrass bed importance on beach response and cross-shore sediment budget; understanding of how changes in offshore wave conditions, bathymetry and seagrass types impact profiles of wave-induced currents and wave evolution over seagrass beds; understanding of the sensitivity of off-the-shelf hydrodynmic models with seagrass present to changes in site conditions.

Goal EA 3: Measure the spread of the invasive seagrass *Halophila stipulace*a 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.							
	Specific milestones						
Objective 3.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
EA 3.1a: Select sampling sites , apply for field permits and order tagging supplies.	Three long term monitoring sites established; permits obtained; marking and measuring supplies purchased.	Sampling permit renewal obtained; seagrass markers maintained or renewed, quadrats fixed or replaced.	Sampling permit renewal obtained; seagrass markers maintained or renewed, quadrats fixed or replaced.			Edwin Cruz-Rivera	
EA 3.1b: Marking seagrass beds and establishing long term transects.	Three *Halophila* beds at <5, ~15 and ~30 m marked and expansion rate measured 2 times a year.	Three *Halophila* beds at <5, ~15 and ~30 m marked and expansion rate measured 4 times a year.	Three *Halophila* beds at <5, ~15 and ~30 m marked and expansion rate measured 2 times a year, data analysis.			Edwin Cruz-Rivera, Graduate student	Detection of natural rates of expansion of the invasive seagrass.
EA 3.1c: Monitoring of environmental conditions at expanding Halophila beds.	Measurements of temperature, salinity, PAR and photosynthesis at 2 times a year.	Measurements of temperature, salinity, PAR and photosynthesis at 4 times a year.	Measurements of temperature, salinity, PAR and photosynthesis at 2 times a year, data analysis.		Manuscript submission and publication.	Cruz-Rivera, graduate and undergraduate students	Will provide first assessment into golden tide algal community structure.

EA 3.1d: Guidance of M.S. thesis on field.	Recruitment of interested graduate student, begin of student courses and research engagement.	Student finishes required graduate courses and is engaged in research; student provides blog entry for EPSCoR site.	Student completes studies, defends MS, presentation at national meeting.	Manuscript submission and publication.		Cruz-Rivera, graduate and undergraduate students	Provides summary of field work and research for internationally read blogs.
	Specific milestones						
Objective EA 3.2	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
EA 3.2a: Lab experiments on *Halophila* growth: light and salinity.		Purchase of growth lights, pots and filters; low-replication pilot experiment run.	Fully factorial growth experiment run, data analysis.	Biochemical analysis of seagrass tissue.		Edwin Cruz-Rivera	Understanding of invasive seagrass response to variation in light and salinity.
EA 3.2b: Lab experiments on *Halophila* growth: light and temperature.		Purchase of heaters, pumps and reservoir tanks, trial run.	Fully factorial growth experiment run, data analysis.	Biochemical analysis of seagrass tissue.	Manuscript submission and publication.	Edwin Cruz-Rivera	Understanding of invasive seagrass response to variation in light and temperature.
EA 3.2c: Undergraduate student recruitment and training.			Recruitment and engagement of undergraduate students in research.	Undergraduate students analyze data with mentor and present work at UVI Research Day.		Edwin Cruz-Rivera	Training of undergraduates will enhance their competitiveness to apply to graduate programs.
EA 3.2d: Proposal development.		Proposal submission based on preliminary data from trial runs.	Proposal resubmission if necessary.	Proposal resubmission if necessary.		Edwin Cruz-Rivera	Pursuit of extramural funding.

Objective EA 3.3	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
EA 3.3a: Feeding experiments with *Halophila* and native seagrasses.	Eight multiple choice laboratory experiments on relative palatability of *Halophila* vs. native seagrass	Eight no-choice laboratory experiments on relative palatability of *Halophila* vs. native seagrass.				Edwin Cruz-Rivera, graduate student	Measurements of palatability of the invasive seagrass provide insights into top-down control of the invader.
EA 3.3b: Exploration of mechanism of deterrence.	Comparisons of nutrient profiles among studied seagrasses (protein, carbohydrates, lipids, C:N ratios).	Analysis of polyphenolics in seagrasses.	Isolation of bioactive metabolites if present.			Edwin Cruz-Rivera, graduate student	Mechanism of low palatability in the invader is elucidated.
Activity EA 3.3c: Graduate student engagement.	Recruitment of interested graduate student, begin of student courses and research engagement.	Student finishes required graduate courses and is engaged in research; student provides blog entry for EPSCoR site.	Student completes studies, defends MS, presentation at national meeting.	Manuscript submission and publication.		Edwin Cruz-Rivera, graduate student	Student development enhances probabilities of employment or further graduate studies.

Objective EA 3.4	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
EA 3.4a: Assessments of seagrass invertebrate diversity in Halophila 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.	Sampling permit renewal obtained; supplies for sample preservation replenished, suction sampling continues twice a year.	Sampling permit renewal obtained; supplies for sample preservation replenished, suction sampling continues twice a year.	Specimen identification, analysis of diversity patterns.	Manuscript submission on seagrass invertebrate diversity.	Edwin Cruz-Rivera, Christopher Rogers, graduate and undergraduate students	Community assessment of invertebrates in communities will elucidate the effects of the invasive species on fish prey at fish nursery habitats and could elucidate reservoirs of invertebrate fish parasites.
EA 3.4b: Description of new species.			Undescribed species described or sent out to experts for characterization.	Submission of manuscripts on new species, undescribed species described or sent out to experts for diagnosis.	Manuscript submission on new species.	Edwin Cruz-Rivera, Christopher Rogers	Contributions to the knowledge in biodiversity of the US Virgin Islands.
EA 3.4c: Proposal preparation.				Proposal submission on marine invasions and biodiversity.	Proposal resubmission if needed.	Edwin Cruz-Rivera, Christopher Rogers	Proposal to establish training opportunities and bridge to the PhD with Univ of Kansas.

Goal EA 4: Analyze the effects of *Sargassum* golden tides on Virgin Islands ecosystems. · Objective EA 4.1: Determine genetic diversity of golden tides. · Objective EA 4.2: Measure the effects of *Sargassum* accumulations of beach biota. · Objective EA 4.3: Measure the effects of decomposing algal accumulations on water quality.							
	Specific milestones						
Objective EA 4.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
Activity EA 4.1a: Establish sampling protocols; obtain permitting; purchase supplies.	Sampling protocols established; permits obtained; molecular genetics supplies purchased.	Molecular genetics supplies replenishment; collection permit renewed.	Molecular genetics supplies replenishment; collection permit renewed.			Edwin Cruz-Rivera, Stacy Krueger-Hadfield	Establishment of project protocols that can be applied to future projects
Activity EA 4.1b: Selecting UAB MS student.	Student identified and begins studies in Marine Biology at UAB.	Student continues studies at UAB; student passes qualifying exam.	Student completes studies in Marine Biology at UAB, defends MS.			Edwin Cruz-Rivera, Stacy Krueger-Hadfield	Student development will enhance employment and graduate study prospects for the student
Activity EA 4.1c: Collect samples; process samples.	Samples collected from min. 3 sites (~50 thalli per site); samples freeze-dried; DNA extracted.	Primers for HiPlex genotyping pipeline developed; year 1 bloom analyzed; year 2 bloom samples extracted.	Year 2 bloom samples analyzed; thesis/ manuscript preparation.	Manuscript submission and publication.		Cruz-Rivera, Krueger-Hadfield, graduate student	Genetic information on Sargassum will provide important insights into the development of golden tides

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.	UAB student writes EPSCOR blog and TME and AGA about field work or recent papers on pop gen.	UAB student writes EPSCOR blog and TME and AGA about lab work or recent papers in popgen.	UAB student writes blog post about manuscript after acceptance.		Cruz-Rivera, Krueger-Hadfield, graduate student	Public education on a topic of territorial interest
Activity EA 4.1e: Capacity building.				Collaborative proposal submitted on *Sargassum* ecological genetics.	Proposal resubmission if necessary.	Edwin Cruz-Rivera, Stacy Krueger-Hadfield	Capacity building and expansion of collaboration with UAB, including the foundation of a bridge to the Ph.D.
Objective EA 4.2	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
Activity EA 4.2a: Select sampling sites , apply for field permits and order trapping and preservation supplies.			Application for collection permit and purchase of pitfall traps, purchase sample preservation and storage supplies.	Renewal of collection permit and replenishment of sample preservation and storage supplies.		Edwin Cruz-Rivera	Archival samples will be among the few documenting beach biota in the Virgin islands.

Activity EA 4.2b: Measuring *Sargassum* effects on beach invertebrates with pitfall traps.			Pitfall traps deployed at two sites with *Sargassum* accumulations and two nearby sites without *Sargassum*, sample preservation and sorting.	Pitfall traps deployed at two sites with *Sargassum* accumulations and two nearby sites without *Sargassum,* sample preservation and sorting, data analysis.		Edwin Cruz-Rivera, Christopher Rogers, graduate student	Trapping results will provide key information on the effect on *Sargassum* on detrital communities of the Virgin Islands.
Activity EA 4.2c: Identification and description of species.				Analysis and description of new species.	Manuscripts on new species (if any) are submitted for publication.	Edwin Cruz-Rivera, Christopher Rogers, graduate student	Contribution to the knowledge of US Virgin Islands biodiversity.
Activity EA 4.2d: Mentoring of a graduate student.			Recruitment of interested graduate student, begin of student courses and research engagement.	Student finishes required graduate courses and is engaged in research; student provides blog entry for EPSCoR site.	Student completes studies, defends MS and submits manuscript for publication; presentation at national meeting.	Edwin Cruz-Rivera, graduate student	Student development will enhance employment and graduate study prospects for the student.
Objective EA 4.3	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
Activity EA 4.3a: Permit application, election of sites with and without *Sargassum* and supplies purchase.			Application for collection permit and purchase of supplies for microbial and nutrient analyses.	Renewal of collection permit and replenishment of supplies for microbial and nutrient analyses.		Edwin Cruz-Rivera	Nutrient analyses can serve as supporting data on other projects.

Activity EA 4.3b: Measuring *Sargassum* decomposition effects on coastal nutrients.			Longitudinal sampling of water during the decomposition cycles of a *Sargassum* accumulation (golden tide) for dissolved nitrogen and phosphorus.	Longitudinal sampling of water during the decomposition cycles of a *Sargassum* accumulation (golden tide) for dissolved nitrogen and phosphorus.		Edwin Cruz-Rivera	Trapping results will provide key information on the effect on *Sargassum* on detrital communities of the Virgin Islands.
Activity EA 4.3c: Measuring *Sargassum* decomposition effects on coliform abundance.			Longitudinal sampling of water during decomposition of a golden tide using Colilert to measure coliform bacteria.	Longitudinal sampling of water during decomposition of a golden tide using Colilert to measure coliform bacteria.	Data analysis and manuscript submission, publocation.	Edwin Cruz-Rivera	Contribution to the knowledge of US Virgin Islands biodiversity.
Activity EA 4.2d - Capacity building				Proposal on golden tide-water quality relations.	Proposal resubmission if necessary.	Edwin Cruz-Rivera	Student development will enhance employment and graduate study prospects for the student.

Fish Ecology

The beneficial role of herbivorous fishes on coral reef resilience is well recognized. However, if the rate of coral reef degradation is rapid or coral reef ecosystems have low resistance or recovery potential following disturbance, this may, in turn, alter the composition of herbivore communities. This Fish Ecology Team will focus on the relationship between habitat composition (turf vs. macro algae) and sedimentation rates (low vs. high) on herbivorous species composition, and the effect of these factors on feeding rates and reproduction of the yellowtail parrotfish (*Sparisoma rubripinne*), as well as how oceanographic variability influences reproductive output. The goals of this research are the following:

Goal FE1

Advance our understanding of how natural and anthropogenic stressors on coral reefs change herbivore (i.e. parrotfish) assemblages. Reef conditions can influence the composition of herbivores on reefs. In turn, understanding the direct and indirect effects of herbivorous fish grazing may amplify or drive the reefs toward macroalgal dominance. Such dominance is often unidirectional and results in loss of coral biodiversity, reduced ecosystem function and resilience. The results can inform the prioritization of mitigation strategies regarding land use and fishing practices. The FE Team will determine if variability in resilience of coral reefs during the 2005/2006 mortality event affected the composition of herbivore fish communities. They will also determine if variability in sedimentation rates onto coral reefs affected the composition of herbivore fish communities.

Goal FE2

Advance our understanding of how benthic characteristics of impacted reefs affect feeding rates and reproduction (frequency of spawning, fecundity) of herbivorous parrotfishes. Parrotfish are important ecological indicators of reef health and function, unfortunately they are overfished in local waters. Understanding the factors that influence their reproduction will inform better management of the fish and their habitat, as well as their role in enhancing coral reef resilience. The FE Team will determine if feeding rates of *Sparisoma* and *Scarus spp.* are affected differently by differences in benthic algal composition and sediment loads. They will also look to see if the frequency of spawning and fecundity of *S. rubripinne* are affected by differences in benthic algal composition and sediment loads.

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. Outputs from this research will help determine larval dispersal pathways from point-source spawning aggregation sites which is essential information for the management of commercial and ecologically important species. The FE Team will determine which oceanographic and environmental variables are most important for frequency of spawning at aggregation sites and specifically determine which oceanographic and environmental variables are most important for reproductive output of *S. rubripinne*.

The impacts of the Fish Ecology research provide a comprehensive and synthetic analysis of the variable influences of watershed processes, coral reef degradation and oceanographic patterns on feeding rates and reproductive output of herbivorous fishes.

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 *Scarus* to *Sparisoma 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 *Scarus 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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	Changes in herbivore fish and benthic communities compared statistically before (2002-2005) and after (2006-2010) the 2005/2006 mortality event. First draft of manuscript completed.				Rick Nemeth, Tyler Smith, Marilyn Brandt, Elizabeth Kadison, Rosmin Ennis, Sarah Heidmann	Peer-reviewed publication/ New perspective on how changes in coral and agal community affects herbivore community. this will provide an important baseline for understanding data from following studies.

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 *Scarus spp.*).	Specific milestones						
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	Data of herbivore communities at sites with variability in sediment flux statistically analyzed. First draft of manuscript completed.				Rick Nemeth, Tyler Smith, Marilyn Brandt, Elizabeth Kadison, Rosmine Ennis	Peer-reviewed publication/ Guide best management practices on harmful effects of terrestrial sedimentation

Objective FE2.1: Determine if feeding rates of *Sparisoma* and *Scarus spp* are affected differently by differences in benthic algal composition and sediment loads	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
FE2.1a: Measure differences in sediment flux among parrotfish feeding sites.	Undergraduate student recruited. Sediment trap locations identified and sediment collectors installed in Reef and Fish Bays (n=20 distributed within two target feeding areas). Sediment traps collected monthly, sediment flux measured and terrigenous component determined. Coordinate sampling and sediment analysis with Watershed group.	Sediment traps collected monthly, sediment flux measured and terrigenous component determined. Data from first 12 months analyzed.	Relationship between sedimentation and feeding rates analyzed. Manuscript submitted.			Rick Nemeth, David Hensley, Sarah Heidmann, grad student, undergrad	Contributes to a more holistic understanding of watershed practices on marine ecological processes.

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 collected on algal composition, turf height and sediment load in filamentous algae using standardized benthic assessment methods in feeding areas (links to Reef Resilience).	Relationship between algal composition characteristics and feeding rates analyzed.			Nemeth, Heidmann, grad student, undergrad	Provides fine resolution data on algal communities/ MS thesis.
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.	Feeding habitats and feeding rates quantified for 30 yellowtail parrotfish (*Sparisoma rubripinne*) at two sites that differ in benthic algal composition and sediment loads. Standardized limestone tiles deployed in parrotfish feeding areas and sediment loads in filamentous algae measured.	Feeding habitats and feeding rates quantified for 30 yellowtail parrotfish (*Sparisoma rubripinne*) at two sites that differ in benthic algal composition and sediment loads. Standardized limestone tiles deployed in parrotfish feeding areas and sediment loads in filamentous algae measured.			Nemeth , Heidmann, grad student, undergrad	Provides quantitative data on feeding patterns of shallow water herbivores under different sediment loads

FE2.1d: Measure differences in parrotfish diet among feeding sites that differ in algal composition and sediment load.		Parrotfish collected (see 2.2a) and digestive tract sent to UPR for diet analysis. Lab-based metabarcoding analysis conducted of stomach contents of yellowtail parrotfish feeding in areas that differ in benthic algal composition and sediment loads. One UVI undergraduate student hosted in Dr. Schizas lab.	Parrotfish collected (see 2.2a) and digestive tract sent to UPR for diet analysis. Lab-based metabarcoding analysis conducted of stomach contents of yellowtail parrotfish feeding in areas that differ in benthic algal composition and sediment loads. One UVI undergraduate student hosted in Dr. Schizas lab.	Data synthesized and analyzed with feeding and spawning rates. First draft of manuscript for publication completed. Preliminary data used to develop new grant proposals.		Rick Nemeth, Chelsea Harmes-Tuohy, Nicholas Schizas	Novel information on dietary differences among feeding habitats. Undergraduate trained in DNA metabarcoding techniques.

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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
FE2.2a: Measure frequency of spawning of *S. rubripinne* 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.	Post-doc hired. Range testing completed. Acoustic data downloaded and receiver array maintained every 6 months. *S. rubripinne* tagged with acoustic transmitters from two feeding sites (n=15/ feeding site) and at two spawning sites (n=15/ site).				Rick Nemeth, Post-Doc, Sarah Heidmann, Elizabeth Kadison, grad student	Will provide data on seasonal and site specific differences in fecundity and spawning site fidelity. Data will provide important information on how feeding habitats affect frequency of visits to spawning aggregation sites.

FE2.2b: Measure fecundity of *S. rubripinne* that feed in areas that differ in benthic algal composition and sediment loads.		Ten (10) female *S. rubripinne* from two spawning aggregation sites collected every four months to determine seasonal and site specific differences in fecundity. Lab based analysis conducted on fecundity, gonad-somatic index and condition factor of female *S. rubripinne* from two spawning aggregation sites.	Ten (10) female *S. rubripinne* collected from two spawning aggregation sites every four months. Fecundity, gonad-somatic index and condition factor measured for female *S. rubripinne* from two spawning aggregation sites. Masters thesis completed.	Data synthesized and first draft of manuscript for publication completed. Preliminary data used to develop new grant proposals.		Rick Nemeth, Post-Doc, Sarah Heidmann, Elizabeth Kadison, grad student	Will provide information on variation in reproductive output of female parrotfish from different feeding and spawning sites. MS thesis published

FE2.2c: Conduct direct and remote observations of spawning activity of *S. rubripinne.*	Methods (visual, auditory) developed for remotely recording spawning activity at two *S. rubripinne* spawning aggregation sites.	Best suited, remote data collection methods deployed on biweekly basis at two *S. rubripinne* spawning aggregation sites to quantify spawning activity. Direct observations (four 30 min video recordings by SCUBA divers during spawning period) over 2 consecutive days conducted biweekly to compare with remotely collected data.	Remote data collection methods deployed on biweekly basis at two *S. rubripinne* spawning aggregation sites to quantify spawning activity. Direct observations (four 30 min video recordings by SCUBA divers during spawning period) over 2 consecutive days conducted biweekly to compare with remotely collected data. Data analysis conducted on first 12 mo. of spawning frequency and environmental variables (link to Goal FE3). Manuscript prepared and submitted.	Remote data collection methods deployed on biweekly basis at two *S. rubripinne* spawning aggregation sites to quantify spawning activity. Direct observations (four 30 min video recordings by SCUBA divers during spawning period) over 2 consecutive days conducted biweekly to compare with remotely collected data. Data analysis conducted on 24 mo. of spawning frequency and environmental variables (link to Goal FE3). Additional manuscripts submitted.		Rick Nemeth, Post-Doc, Sarah Heidmann, Elizabeth Kadison, grad student	Will provide novel approaches to remotely monitor spawning aggregation sites.

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 *S. rubripinne*.							
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
FE3.1a: Measure oceanographic features at spawning aggregation sites.		One set of oceanographic and environmental sensors deployed at each spawning aggregation site. Other sources of data from ocean buoys, thermistors, weather stations, etc. incorporated into analysis.	Statistical relationship between oceanic and environmental variables on reproductive output examined (using data from Goal 2).			Rick Nemeth, Sennai Habtes	Peer reviewed manuscript/ Will provide statistical analysis of relationship between ocean and environmental variables affecting frequency of spawning at two parrotfish aggregation sites.

Objective FE3.2: Determine which Oceanographic and environmental variables are most important for reproductive output of *S. rubripinne.*	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
FE3.2a: Measure fecundity of *S. rubripinne* that feed in areas that differ in benthic algal composition and sediment loads.		On-site plankton collection methods developed using diver operated plankton nets and collection bags.	Gamete clouds collected at spawning sites. Characteristics of S. rubripinne egg structure and preflexion larvae identified.	Gamete clouds collected at spawning sites and data analyzed relative to seasonal oceanographic and environmental conditions.	Coordinate sampling with Oceanography group (Habtes).	Rick Nemeth, Sennai Habtes	Will allow us to identify characteristics of S. rubripinne egg structure and preflexion larvae.
FE3.2b: Examine egg and pre-flexion larvae dispersal patterns.			Plankton tows conducted monthly in a 1km radius around each spawning site to determine *S. rubripinne* egg production and dispersal patterns.	Plankton tows conducted monthly in a 1km radius around each spawning site to determine *S. rubripinne* egg production and dispersal patterns.	Data synthesized and first draft of manuscript for publication completed. Preliminary data used to develop new grant proposals.	Nemeth, Habtes	Will determine *S. rubripinne* egg production (link to oceanography)

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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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. Contribute 2 products or events per year.	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Contribute 2 products or events per year.	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Contribute 2 products or events per year.	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Contribute 2 products or events per year.	Assist with information dissemination by advising communications department on achievements, activities and items of import. Provide photos when possible. Contribute 2 products or events per year.	Nemeth, Kadison, Post doc, graduate student, undergraduate student	Research of watershed impacts on ecological processes of fish feeding and reproduction shared with a broad audience

FE4.1b: Share research through community outreach events (e.g., Reef Fest, Sip N' Science).	Participate in 1 event per year.	Participate in 1 event per year.	Participate in 1 event per year.	Participate in 1 event per year.	Participate in 1 event per year.	Nemeth, Kadison, Post doc, graduate student, undergraduate student	Research of watershed impacts on ecological processes of fish feeding and reproduction shared with a broad audience
FE4.1c: Integration Activity: EPSCoR website development.	Review, advise & inform new content semi-annually on viepscor.org website to accurately reflect R2R goals and achievements.	Review, advise & inform new content semi-annually on viepscor.org website to accurately reflect R2R goals and achievements.	Review, advise & inform new content semi-annually on viepscor.org website to accurately reflect R2R goals and achievements.	Review, advise & inform new content semi-annually on viepscor.org website to accurately reflect R2R goals and achievements.	Review, advise & inform new content semi-annually on viepscor.org website to accurately reflect R2R goals and achievements.	Nemeth, Kadison, Post doc, graduate student, undergraduate student	EPSCoR Website developed
FE4.1d: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department annually with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department annually with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department annually with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department annually with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department annually with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Nemeth, Kadison, Post doc, graduate student, undergraduate student	EPSCoR Newsletter developed

Objective FE4.2: Provide opportunities for student training and enrichment.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
FE4.2a: Engage undergraduate students in fish ecology research.		1 undergraduates engaged as intern with Univ. of Puerto Rico (N. Schizas lab - see FE2.1d).	1 undergraduates engaged as intern with Univ. of Puerto Rico (N. Schizas lab - see FE2.1d).	2 undergraduates engaged in fish ecology research.	2 undergraduates engaged in fish ecology research.	Nemeth	4-6 undergraduates engaged in the geosciences.
FE4.2b: Engage graduate students in fish ecology research.	1 graduate student engaged in fish ecology research.	2 graduate students engaged in fish ecology research.	2 graduate students engaged in fish ecology research.	2 graduate students engaged in fish ecology research.		Nemeth	At least 2 graduate students engaged in the geosciences.

Objective FE4.3: Participate in professional development opportunities that boost communication of research and strengthen partnerships.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
FE4.3a: Participate in R2R writing workshops.	Workshop participation.	Workshop participation.	Workshop participation.	Workshop participation.	Workshop participation.	Nemeth, Kadison, Post doc	New partnerships formed, grant proposals, and/or publications drafted and submitted.
FE4.3b: Attend and share research efforts at local, national and international conferences.	Participate in 1 conference per year.	Participate in 1 conference per year.	Participate in 1 conference per year.	Participate in 1 conference per year.	Participate in 1 conference per year.	Nemeth, Kadison, Post doc, graduate students, undergraduate students	Dissemination of data to the community. Strengthening of partnerships and research opportunities.
FE4.3c: Integration Activity: Attend annual VI EPSCoR Conference.		Participate in VI-EPSCoR annual conference.	Participate in VI-EPSCoR annual conference.	Participate in VI-EPSCoR annual conference.	Participate in VI-EPSCoR annual conference	Nemeth, Kadison, Post doc, graduate students, undergraduate students	Dissemination of data to the R2R team. Strengthening of partnerships and research opportunities.

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 goals of these research activities are:

Goal OC1

Quantify the influence of oceanographic and environmental variables on the variability in reproductive rates (frequency of spawning and fecundity) of S. rubripinne. As noted earlier in the Fish ecology (FE3) discussion, increasing our understanding of the variables influencing these ecologically important fish can lead to improved management of the fish and their habitat. The OC Team will determine which oceanographic and environmental variables are relevant at spawning aggregation sites and other R2R research sites. They will also quantify the frequency of spawning and fecundity (abundance of eggs and pre-flection larvae) of *S. rubripinnis* at Reef Bay, St. John.

Goal OC2

Determine larval dispersal pathways from point-source spawning aggregation sites of S. rubripinne. Insights into the linkage and distribution of larval and juvenile populations with the spawning sites of the parents is a powerful fisheries management tool that can help manage the species. The OC Team will use ichthyoplankton abundance data and regional ocean modeling system (ROMS) to model dispersal, and if possible, retention pathways.

Goal OC3

Share USVI Oceanography Research with Stakeholders & Provide Opportunities for New Partnerships. A key element of the R2R program is to disseminate key findings and outputs to the public and essential stakeholders. These efforts can educate and inspire students and the general citizenry, and help inform decision makers with critical natural resource management guidance. The OC Team will share oceanography research through IL and EWFD integration activities, community events, and other opportunities. They will provide opportunities for student training and enrichment, and participate in professional development opportunities that boost communication of research and strengthen partnerships.

The impacts from the oceanographic research will integrate the influence of oceanographic, environmental, and terrestrial inputs on the reproductive ecology and larval dispersal of a common species of coral reef fish. The research will identify drivers associated with reef fish fecundity and dispersal that affect coral reef resilience and develop a lasting infrastructure for shipboard coastal oceanographic research in the USVI. This research will provide researchers, managers, and stakeholders in the territory with additional information on drivers impacting the resilience of reef fish populations, and develop opportunities for increased engagement with the scientific and local community through opportunities for collaborative oceanographic research and dissemination of oceanographic data products.

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 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 pre-flection larvae) of *S. rubripinnis* at Reef Bay, St. John during spawning periods;							
	Specific milestones						
Objective OC1.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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 parameters and spatial/temporal scales of measurement of the oceanographic & environmental variables, survey sites and develop deployment plans of sensors to capture measurements needed to inform model.	Complete purchase of, deployment, data management and equipment maintenace plans for, and complete deployment of all oceanographic equipment.	Ensure accurate data collection, QA/QC, and archiving, regular equipment calibration and maintenance, including deployment and recovery schedules, and manuals for major oceanographic equipment.	Finalize 2-3 yr dataset of oceanographic, environmental, and terrestrial data for reef bay.	Finalize archiving of oceanographic equipment datasets for archiving and external use, OCE1.1b. Coordinate and develop tracking oceanographic data product view/use.	V. McKague, S. Habtes, R. Nemeth, A. Breton, D. Wilson, S. Mukherjee, MMES Graduate Student	We identify the most common environmental and oceanographic variables that influence reproductive rates in *S. rubripinnis.*

OC1.1b: Examine statistical relationship between oceanic and environmental variables on reproductive output (using data from OCE1.2).	- Develop time-series database of oceanographic, environmental, and terrestrial data for reef bay site (OCE1.1a) and identify appropriate statistical model.	- Build model/ analysis, and test model/analysis using NOAA NMFS USVI CRER database of larval *Scaridae* and *Sparisoma* abundance.	Initialize model using data collected in year 2 at reef bay site, and advertise for 1 graduate and undergraduate Research Assistants for OCE1.1b.	Run and iteratively test statistical model to identify which variables contribute most to variability in *S. rubripinne* reproductive output, and have 1 MMES student defend thesis related to OCE1.1b research. Recruit 1 MMES graduate student and 1 UVI undergraduate student.	Submit 1 manuscript for publication. Share data with interested stakeholders particularly CFMC through EBFM TAP, and E&O group via 1pager or presentation at CFMC general meeting.	S. Habtes & MMES Grad student, V. McKague, R. Nemeth, A. Breton, S. Mukherjee, MMES Graduate student	We identify the most common environmental and oceanographic variables that influence reproductive rates in *S. rubripinnis.*

Objective OC1.2	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
OC1.2a: Conduct plankton tows at reef bay to determine characteristics of S. rubripinne preflexion larvae and larval starting points for connectivity envelope analysis.	Complete site surveys at Reef Bay, develop pelagic larval duration tables for *Scarid* and *Sparisoma*, and design ichthyoplankton survey and collection protocols. Identify meristic/ phenotypic characteristics of larvae or eggs to use in analysis. Advertise for 1 graduate and undergraduate research assistants for OCE1.2a/ OCE1.3a.	Recruit 1 MMES graduate student and 1 UVI undergraduate students for OCE1.2a/ OCE1.3a.	Conduct sampling of *S. rubripinne* fecundity at Reef Bay, and summarize fecundity data on *Sparisoma spp.* from NOAA SEFSC CRER Database. Engage at least 1 MMES graduate student and undergraduate students in research.	Develop database of oceanographic factors and egg abundance, and use in a statistical model to assess the influence of oceanographic factors on egg production during spawning.	Develop one manuscript, graduate 1 MMES student and produce 1 research output for US Caribbean stakeholders.	S. Habtes and MMES graduate student, V. McKague, R. Nemeth, NOAA SEFSC AOML & FORCES lab personnel, Oce Lab undergraduate researchers	We identify terrestrial and oceanographic drivers that influence reproductive outputs of *S. rubripinne*, and identify connectivity pathways for *S. rubripinne* from reef bay, STJ.

Objective OCE1.3	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
OC1.3a: Identify fecundity potential and drivers influencing it during spawning aggregations of *S. rubripinne* at Reef Bay, STJ.	Complete 2 site surveys at Reef Bay to design collection of egg clouds via SCUBA/ship and design survey and collection protocols for egg collection during spawning.	Collect *S. rubripinne* egg and larvae during sampling at Reef Bay and summarize fecundity data on *Sparisoma spp.* from NOAA SEFSC CRER Database. Recruit at least 1 UVI graduate & undergraduate students for OCE1.2a/ OCE1.3a.	Collect *S. rubripinne* egg and larvae during sampling at Reef Bay and summarize fecundity data on *Sparisoma spp.* from NOAA SEFSC CRER Database. Recruit at least 1 UVI graduate & undergraduate students for OCE1.2a/ OCE1.3a.	Develop database of oceanographic factors and egg abundance and assess the influence of oceanographic factors on egg production of *S. rubripinne* during spawning.	Graduate 1 MMES student associated with OCE1.2a/ OCE1.2b research and produce research outputs for local outreach and stakeholder engagement and dissemination.	S. Habtes and MMES graduate student, V. McKague, R. Nemeth, A. Breton, D. Wilson, S. Mukherjee	We identify terrestrial and oceanographic drivers that influence reproductive outputs of *S. rubripinne*, and identify connectivity pathways for *S. rubripinne* from reef bay, STJ.

Goal OC2: Determine larval dispersal pathways from point-source spawning aggregation sites of *S. rubripinne*. · 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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
OC2.1a: Develop realistic hydrodynamic outputs from the US Caribbean Regional Ocean Modelling System.	Develop an US Caribbean coastal ocean model (USCCOM) based on ROMS architecture with finer resolution (300 m) and develop an LTRANS connectivity module to model larval dispersal of *S. rubripinne* from Reef Bay, STJ.	- Develop the computing infrastructure and protocols for data sharing between UVI and (D. Holstein at LSU). Integrate the USCCOM with data assimilation for improved performance and Secure 1 source of extramural funding to extend physical oceanographic research.	Upgrade the USCCOM infrastructure for shared output to US Caribbean stakeholders and develop 1 manuscript for publication.			S. Mukherjee, S. Habtes, D. Holstein, T. Smith, A. Breton, D. Wilson, P. Jobsis	We develop an fine-scale operational Regional Ocean Circulation model for the USVI that can be used by US Caribbean stakeholders.

OC2.1b: Integrate oceanographic and environmental variables, coral reef condition, parrotfish reproductive output, and connectivity models parameterized from regional ocean models.	Summarize all available oceanographic, environmental, and terrestrial R2R data for use in mixed statistical model.	Historical data analysis and model testing using CRER database and larval abundance and R2R Reef Bay data.	Historical data analysis and model testing using CRER database and larval abundance and R2R Reef Bay data.	Use statistical model to asses influence of oceanographic and environmental variables on S. rubripinne dispersal from Reef Bay, STJ spawning sites and develop research outputs, for outreach and stakeholder dissemination.	Develop research outputs for US Caribbean stakeholders (CariCOOS – OCE data products; CFMC presentation, and 1 pager.)	S. Habtes, S. Mukherjee, R. Nemeth,V. McKague, MMES graduate student	We identify oceanographic and environmental drivers of reproductive output and dispersal pathways of *S. rubripinne*.

Objective OC2.2	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
OC2.2a: Develop more permanent physical and human infrastructure to conduct oceanographic research.	Develop working group for oceanographic vessel management and infrastructure development and identify contractors abd begin oceanographic instrumentation upgrades and refit.	Complete vessel refit for research needed in OCE1.3, and identify and secure extramural funding to hire additional vessel staff.	Develop protocols and infrastructure for improved oceanographic data collection, and data product development and distribution for US Caribbean Stakeholders, and increase use of VI EPSCoR data products by regional stakeholders.	Identify 2 new oceanographic data products to share with stakeholders through regional partners and increase coastal ocean vessel use by securing at least 1 contract for external vessel use.		S. Habtes, V. McKague, D. Wilson, P. Jobsis, K. Waddell, Vessel Management Steering Committee	We will develop the necessary human and physical infrastructure to maintain a coastal oceanographic research vessel program that will increase collaborative research with institutions outside the US Caribbean and establish a platform for training of graduate & undergraduate students on oceanographic research.

Goal OC3: Share USVI Oceanography Research with Stakeholders & Provide Opportunities for New Partnerships · Objective OC3.1: Share oceanography research through EOD and VI-ISERP integration 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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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 to 2 products or events per year.	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 to 2 products or events per year.	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 to 2 products or events per year.	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 to products or events per year.	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.	S. Habtes, V. McKague, graduate students, undergraduate students	We share R2R Oceanography research with a broader audience.

OC3.1b: Share research through community outreach events (e.g., VI-EPSCoR Annual Conference)	Participate in 1 event per year.	Participate in 1 event per year.	Participate in 1 event per year.	Participate in 1 event per year.	Participate in 1 event per year.	S. Habtes, V. McKague, S. Mukherjee, A. Breton, graduate students, undergraduate students	We share R2R Oceanography activities and products with local audiences.
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.	Participate in 1 event per year.	Participate in 1 event per year.	Participate in 1 event per year.	Participate in 1 event per year.	S. Habtes, V. McKague, graduate students, undergraduate students	We improve and increase UVI early career faculty development and potential student professional development opportunities.
OC3.1d: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.	S. Habtes	We develop content for the EPSCoR Website and increase dissemination of research outputs to regional and national stakeholders.

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.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	S. Habtes, V. McKague, S. Mukherjee, A. Breton, D. Wilson, graduate students, undergraduate students	We develop a regular EPSCoR Newsletter and increase dissemination of research outputs to regional and national stakeholders.
Objective OC3.2 Provide opportunities for student training and enrichment.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
OC3.2a: Engage undergraduate students in oceanography research.	Advertise and recruit for at least 1 undergraduate student	1 undergraduate engaged.	1 undergraduate engaged.	1 undergraduate engaged.	1 undergraduate engaged.	S. Habtes, V. McKague, D. Wilson, P. Jobsis	We engage 2-5 undergraduates in the geosciences.
OC3.2b:Engage graduate students in oceanography research.		1 graduate student engaged (OCE1.2a/b).	2 graduate student engaged (OCE1.2a/b).	1 graduate student engaged (OCE 1.1b).	1 graduate student engaged (OCE 1.1b).	S. Habtes	We engage 2 graduate students in the geosciences.

OC3.2c: Explore synergies for student training an enrichment with other partners and programs.	Opportunities for synergies with programs like the UVI SEAS Alliance, UVI NSF Strong Coasts NRT, CariCOOS & OOCOVI for student research, funding, and professional development will be explored as they arise.	Opportunities for synergies with programs like the UVI SEAS Alliance, UVI NSF Strong Coasts NRT, CariCOOS & OOCOVI for student research, funding, and professional development will be explored as they arise.	Opportunities for synergies with programs like the UVI SEAS Alliance, UVI NSF Strong Coasts NRT, CariCOOS & OOCOVI for student research, funding, and professional development will be explored as they arise.	Opportunities for synergies with programs like the UVI SEAS Alliance, UVI NSF Strong Coasts NRT, CariCOOS & OOCOVI for student research, funding, and professional development will be explored as they arise.	Opportunities for synergies with programs like the UVI SEAS Alliance, UVI NSF Strong Coasts NRT, CariCOOS & OOCOVI for student research, funding, and professional development will be explored as they arise.	S. Habtes, V. McKague, D. Wilson, P. Jobsis	We will identify and secure additional funding, professional development and research opportunities for students through partnerships with these and other programs as they arise.
Objective OC3.3 Participate in professional development opportunities that boost communication of research and strengthen partnerships.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	Workshop and working group meeting participation.	Workshop and working group meeting participation.	Workshop and working group meeting participation.	Workshop and working group meeting participation.	S. Habtes, V. McKague, S. Mukherjee	This engagement will allow for new partnerships formed, grant proposals, and/or publications drafted and submitted.

OC3.3b: Attend and share research efforts at local, national and international conferences, meetings, or workshops.	Participate in 1 per year.	Participate in 1 per year.	Participate in 1 per year.	Participate in 1 per year.	Participate in 1 per year.	S. Habtes, V. McKague, S. Mukherjee, undergraduate & graduate students	We will Disseminate data and research findings to the community, and strengthen partnerships and research opportunities.
OC3.3c: Integration Activity: Attend annual VI EPSCoR Conference.		Participate in VI-EPSCoR annual conference.	Participate in VI-EPSCoR annual conference.	Participate in VI-EPSCoR annual conference.	Participate in VI-EPSCoR annual conference.	S. Habtes, V. McKague, S. Mukherjee	We will dissemination data to the R2R team, local and regional stakeholders and strengthen partnerships and research opportunities.

Marine Disease and Restoration

The impacts of reduced coral resilience are characterized as coral disease and mortality. The goal of the Marine Disease Research (MD) team is to understand how diversity of coral species affects coral disease, which is an important driver of resilience in coral reef communities. Many coral diseases affect multiple species of corals, and reefs are composed of different assemblages of coral species. These assemblages are distributed across a range of water quality. MD addresses how species diversity interacts with water quality to affect the spread and impact of coral disease.

The goal of the coral restoration research is to identify how species diversity and water quality affects the success of coral outplanting. While many coral restoration programs focus on one or two coral species exclusively, the Team acknowledges that important species interactions can influence establishment and growth of outplanted corals through processes such as facilitation (promotion) or competition (inhibition). Regional decline of coral populations are caused by stressors, including declines in local water quality and global changes including temperature, yet how these factors affect the success of coral outplanting among reef sites has not been examined. This research area addresses gaps in our understanding by experimentally testing how species diversity and different water quality regimes affect the growth, health, and survival of coral outplants.

Goal MD1

Determine how species biodiversity affects the spread and impact of coral disease. The MD Team will analyze existing data sets that have mapped disease prevalence across a range of species assemblages. This work will be complemented with disease transmission experiments involving selected species assemblages.

Goal MD2

Determine how local stressors (e.g., nutrients, turbidity) and global stressors (e.g., temperature stress) drive temporal and spatial distributions of disease. Understanding the relative impact of both global and local stressors on the distribution of disease will help prioritize strategies for mitigating the impacts by natural resource managers in the Territory. The MD team will test the effect of water quality and temperature stress on disease prevalence and transmission.

Goal MD3

Predict the spread and impact of multi-species coral disease. The MD Team will develop a connectivity-based disease spread model and a species assemblage map for the region. The team will also test the effect of influential species assemblage parameters and influential water quality parameters on disease spread model accuracy.

Goal MD4

Share Disease (and Restoration) Research with Stakeholders through participation in outreach and education activities. Coral ecosystems are locally recognized for their value as a tourism attraction, as well as providing habitat for commercially important fish species, but there is much more to be shared with many members of the VI community, so sharing research from this area will improve environmental literacy with the public.The MD Team will share information through planned IL and EWFD activities, as well as participating in professional development activities.

Goal MR1

Expand capacity for restoration ecology research in the US Virgin Islands. The VI-EPSCoR leadership will hire a restoration ecologist as research faculty to expand the research opportunities for UVI's students and R2R colleagues.

Goal MR2

Determine how diversity affects success of coral outplanting. The MR Team will compare growth and survival of outplanted corals among different species configurations.

Goal MR3

Determine how gradients in water quality affect success of coral outplanting. The MR Team will measure growth and survival of outplanted corals across a range of water quality conditions.

The overall impact of the Marine Disease and Restoration Research effort will include a more detailed understanding of how species diversity predicts the spread and impact of disease among diverse coral communities, and how diversity affects the potential and success of coral restoration activities. Results from experiments will be submitted for peer-review publication, contributing to the disciplines of marine disease and coral restoration. Students at the graduate and undergraduate levels will be included in research activities, and results will be shared with the local community through EPSCoR outreach events and through other VI EPSCoR channels.

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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
MD1.1a: Quantify disease across species assemblages using existing datasets	Datasets on disease and species composition identified and compiled.	Analysis of disease and species assemblages completed.	Manuscript submitted on disease and species assemblage linkages.			Marilyn Brandt, Tyler Smith	Understanding of how species susceptibility affects disease prevalence among reef habitats.
Objective MD1.2: Quantify disease incidence among experimental species assemblages	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
MD1.2a: Involve one MMES student and one undergraduate in experiment.		Recruitment of MMES student and undergraduate.	Involvement of MMES student and undergraduate in research.	MMES student finishes.		Marilyn Brandt	Student participation in research, MS thesis.
MD1.2b: Acquire necessary research permit from USVI Division of Fish and Wildlife for experimentation.		Permit applied for/ acquired.				Marilyn Brandt, Marine Disease Technician, MMES student	Permit for experiment.

MD1.2c: Experimentally test disease transmission in mesocosms with specific species compositions.		Experiment initiated.	Experiment completed.	Analysis of experiment completed.		MMES student, Marine Disease Technician, undergraduates.	Understanding of transmission dynamics among tested species assemblages in a controlled setting.
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 transmissioned.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
MD2.1a: Use existing data sets to investigate disease prevalence in relationship to locally driven water quality parameters and temperature stress.		Data sets on local water quality parameters, thermal stress and disease prevalence compiled - output from Coral Resilience section.	Key parameters associated with disease prevalence identified.			Marilyn Brandt, Tyler Smith, Marine Disease Technician	Results on relationships between disease and locally driven water quality parameters.
MD2.1b: Involve one MMES student and one undergraduate in experiments.			Recruitment of one MMES student and one undergraduate.	Involvement of MMES student and undergraduate in research.	MMES student finishes.	Marilyn Brandt	Student participation in research, MS thesis.
MD2.1c: Acquire necessary permit from USVI Division of Fish and Wildlife for experimentation.			Research permit applied for/ acquired.			Marilyn Brandt, Marine Disease Technician,MMES student	Permit for experiment.

Activity MD2.1d: Perform lab-based transmission experiment under different levels of temperature stress (levels: no stress, moderate, severe).			Permits aquired and experiment started.	Experiment completed.	Analysis of experiment completed.	Marilyn Brandt, MMES student, Marine Disease Technician	Data on disease transmission in relationship to temperature stress.
MD2.1e: Perform lab-based transmission experiment under three different levels of one local water quality parameter determined to be important in Activity MD2.1a.			Permits aquired and experiment started.	Experiment completed.	Analysis of experiment completed.	Marilyn Brandt, MMES student, Marine Disease Technician	Data on disease transmission in relationship to local water quality parameter.
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
MD3.1a: Use hydrodynamic model outputs to parameterize a connectivity model for the northern Virgin Islands.		Produce final metrics/model runs to assign network placement for long-term coral reef sites and spatially randomized sites (aligns with Coral Resilience)				Daniel Holstein, Tyler Smith	Connectivity network for use in modeling.

Objective D3.2: Develop coral species assemblage map for region	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
MD3.2a: Identify and combine existing data sources for coral species assemblages.	Team assembled and working towards database production of stony coral diversity at long-term sites [links to Coral Resilience Objectives 1.1.b and 1.2].	Database of diversity at long-term sites completed [links to Coral Resilience Objective 1.1.b].				Tyler Smith, Marilyn Brandt, Daniel Holstein, Peter Edmunds, Jeff Miller, Caroline Rogers, Leslie Henderson	First of its kind dataset on coral attributes in the USVI. Possible manuscript.
MD3.2b: Produce basic species distribution grid.		Identify/develop spatial grid.	Produce coral species assemblage grid with links to connectivity model.			Marilyn Brandt, Tyler Smith, Marine Disease Technician	Species assemblage grid for US Virgin Islands.
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
Activity D3.3a: Hire post-doc			Begin process of hiring post-doc	Post-doc begins work		Brandt	Post-doc hired

MD3.3b: Use model framework to determine how species diversity (Goal 1.1) and water quality (Goal 1.2) affect coral disease spread.				Post-doc works to combine modeling framework with databases and perform testing.	Model framework and testing complete.	Marine disease postdoc, Marilyn Brandt, Daniel Holstein, Tyler Smith, Mukherjee, Sennai Habtes	Understanding of how species diversity and water quality affect disease spread.
Goal MD4: Share Disease Research with Stakeholders through participation in outreach and education activities. · Objective MD4.1: Share information through planned IL and EWFD 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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	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.	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.	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.	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.	Marilyn Brandt, Marine Disease Technician, MMES students, undergraduates	Disease research shared with a broad audience.
MD4.1b: Share research through community outreach events (e.g., Reef Fest, Sip N' Science).	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Marilyn Brandt, Marine Disease Technician, MMES students, undergraduates	Restoration activities shared with local audiences

Activity D4.1c: Integration Activity: Participate in VI-ISERP activities	TDB	TDB	TDB	TDB	TDB	Marilyn Brandt, Marine Disease Technician, MMES students, undergraduates	USVI teacher professional development, potential student professional development
MD4.1d: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.					Marilyn Brandt	EPSCoR Website developed.
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.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Marilyn Brandt, Marine Disease Technician, MMES students, undergraduates	EPSCoR Newsletter developed.
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
MR1.1a: Hire faculty	Develop request for proposal for Research faculty; advertise through UVI Human Resources; Assemble hiring committee; Review applicants.	Restoration Ecologist position begins.				Marilyn Brandt, Kim Waddell, Paul Jobsis	Restoration Ecologist hired.

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 outplanted corals among different species configurations.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
MR2.1a: Involve one MMES student and one undergraduate in experiments.		Recruitment of MMES student and undergraduate.	Involvement of MMES student and undergraduate in research.	MMES student finishes.		Marilyn Brandt	Student participation in research, MS thesis.
MR2.1b: Acquire necessary permit from USVI Division of Fish and Wildlife for experimentation.		Permit applied for/ acquired.				Marilyn Brandt, MMES student	Permit for experiment.
MR2.1c: Perform diversity in outplanting experiment among at least three sites.		Permits aquired and experiment started.	Species diversity effect on outplanting success experiment completed.	Analysis of experiment completed.		Marilyn Brandt, MMES student	Understanding of how species diversity affects success of outplanting.
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
MR3.1a: Involve one MMES student and one undergraduate in experiments.			Recruitment of one MMES student and undergraduate.	Involvement of MMES student and undergraduates in research.	MMES student finishes.	Marilyn Brandt	Student participation in research, MS thesis.

MR3.1b: Acquire necessary permits from USVI Division of Fish and Wildlife for experimentation.			Permit applied for/ acquired.			Marilyn Brandt, MMES student	Permit for experiment.
MR3.1c: Outplanting at six sites representing a range of water quality			Permits aquired, Outplanting begins.	Assessment of outplants.	Experiment completed, Analysis completed.	Marilyn Brandt, MMES student	Understanding of how water quality affects success of outplanting.
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	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.	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.	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.	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.	Marilyn Brandt or Restoration Ecologist Hire, MMES students, undergraduates	Restoration research shared with a broad audience.

MR4.1b: Share research through community outreach events (e.g., Reef Fest, Sip N' Science).	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Marilyn Brandt or Restoration Ecologist Hire, MMES students, undergraduates	Restoration activities shared with local audiences.
MR4.1c: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.					Marilyn Brandt	EPSCoR Website developed.
MR4.1d: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Marilyn Brandt or Restoration Ecologist Hire, MMES students, undergraduates	EPSCoR Newsletter developed.

Objective MR3.1: Measure growth and survival of outplanted corals across range of water quality.	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
MR3.1a: Involve one MMES student and one undergraduate in experiments.			Recruitment of one MMES student and undergraduate.	Involvement of MMES student and undergraduates in research.	MMES student finishes.	Marilyn Brandt	Student participation in research, MS thesis.
MR3.1b: Acquire necessary permits from USVI Division of Fish and Wildlife for experimentation.			Permit applied for/ acquired.			Marilyn Brandt, MMES student	Permit for experiment.
MR3.1c: Outplanting at six sites representing a range of water quality			Permits aquired, Outplanting begins.	Assessment of outplants.	Experiment completed, Analysis completed.	Marilyn Brandt, MMES student	Understanding of how water quality affects success of outplanting.
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	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.	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.	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.	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.	Marilyn Brandt or Restoration Ecologist Hire, MMES students, undergraduates	Restoration research shared with a broad audience.

MR4.1b: Share research through community outreach events (e.g., Reef Fest, Sip N' Science).	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Marilyn Brandt or Restoration Ecologist Hire, MMES students, undergraduates	Restoration activities shared with local audiences.
MR4.1c: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.					Marilyn Brandt	EPSCoR Website developed.
MR4.1d: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Marilyn Brandt or Restoration Ecologist Hire, MMES students, undergraduates	EPSCoR Newsletter developed.

Coral Reef Resilience

Reefs in the Caribbean typically show less stability, the ability to resist change after disturbances, and have slower recovery to pre-disturbance form and function compared to Indo-Pacific populations. Increased climate variability has led to increases in the intensity and frequency of hurricanes. Poor land use leads to sediment deposit and eutrophication. The Coral Resilience (CR) Team will examine multiple drivers and mechanisms to understand why some locations show resilience where others show precipitous declines in coral cover. Key drivers likely to impact coral reef resilience include variation in biodiversity, magnitude and frequency of thermal and storm disturbances, resistance to coral disease, herbivory rates, and exposure to land-based run-off and water quality.

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. Addressing this goal will provide substantive insights to guide the monitoring and management of the Territory's coral reef ecosystems - a key goal of both the US and Virgin Islands governments. The CR Team will create a comprehensive database of external drivers (biophysical regimes) and internal drivers (biological characteristics and processes) 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. The Team will also develop metrics describing biological resilience (resistance and recovery) at the same research sites, including trajectories of diversity and abundance of corals and associated biota. They will identify gaps in knowledge within databases of biophysical drivers and response variables at each location that need additional information. Finally the CR Team will 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.

Goal CR2

Understand the impact of regional larval connectivity patterns on biodiversity patterns. Understanding the source and sinks of coral reproduction and distribution is essential to their protection and management. The CR Team will develop a regional connectivity model for coral reef organisms and determine the network and habitat connectivity metrics and corresponding estimates of biodiversity. The Team will then analyze the relationship between realized diversity and connectivity, stress, and past disturbances.

Goal CR3

Share Coral Reef Resilience Research with Stakeholders through participation in outreach and education activities. Coral ecosystems are locally recognized for their value as a tourism attraction, as well as providing habitat for commercially important fish species, but there is much more to be shared with many members of the VI community, so sharing research from this area will improve environmental literacy with the public. The CR Team will share information through planned IL and EWFD activities, and participate in professional development activities with teachers and UVI students.

The impacts from the coral reef resilience research will uncover the internal and external drivers behind contrasting resistance and recovery of coral reefs to stress and disturbance in the northeastern Caribbean. This will provide a mechanistic understanding that can provide a solid foundation for management actions to improve coral reef condition and can be contrasted with other systems, such as the Indo-Pacific. Coral connectivity research will create an understanding of how connectivity networks shape biodiversity of coral reefs. This will provide management with information to guide coral restoration and protection activities

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 infuence 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, identigy most critical internal and external drivers on ecosystem resilience and targets for restoration of resilience.

	Specific milestones						
Objective CR1.1. External Drivers	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	Database produced of thermal regimes. Characteristics of thermal regimes analyzed (long-term means, variability, thermal extremes/ marine heat waves, drivers such as doldrums and Amazon/ Orinoco river plumes).				Tyler Smith, Viktor Brandtneris, Doug Wilson, Sonaljit Mukherjee, Sennai Habtes, Rosmin Ennis	An understanding of the USVI thermal regimes from surface to 100 m and how that can potentially impact coral ecosystems.

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.	Database produced of wave and benthic orbital velocity regimes. Characteristics of wave regimes analyzed (long-term means, variability, extremes and potential for disturbance, cumulative energy).				Sonaljit Mukherjee, Miguel Canals (UPR Mayaguez)	An understanding of how wave regimes vary across the USVI and how those regimes can shape coral ecosystems through disturbance (storms and swells) and mean conditions (wave-tolerant/ dependent and wave-intolerant faunas)
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.	Produce a description of the benthic current regimes at each of the long-term monitoring sites based on the hydrodynamic model.				Sonaljit Mukherjee, Miguel Canals (UPR Mayaguez), Sennai Habtes, Doug Wilson, Daniel Holstein	Multiple years of current model runs to feed into the connectivity modeling system. An understanding of long-term current regimes and how they might impact coral communities.

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.	Develop a vulnerability index of each long-term monitoring site to land-based run off of sediments and pollutants.				Tyler Smith, Ali Adem, Joseph Ortiz, Marilyn Brandt, Daniel Holstein	A spatiotemporal understanding of water quality around the USVI, with particular emphasis on water quality affecting coral reefs. Provides validation outputs for the [Watershed Studies] through ocean color characterization from remotely sensed data and, potentially, through modeled sediment plume connectivity.
CR1.1e: Compile physical oceanography drivers into geographic surfaces to characterize the physical regimes around the USVI.		Georeferenced surface of physical oceanography regimes produced.	Manuscript characterizing the physical environments of the USVI shelf systems from 1-100 m depth.			Tyler Smith, Sonaljit Mukherjee, and all others involved in physical drivers research	A spatiotemporal understanding of physical oceangraphy and driver regimes around the USVI that can be used in multiple lines of ecosystem research.

Objective CR1.2. Internal Drivers	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	Database of diversity at 42 long-term coral reef monitoring sites completed. Analysis of site groupings using multivariate statistics to provide background material for understanding attributes of 42 long-term coral reef monitoring sites.				Tyler Smith, Marilyn Brandt, Daniel Holstein, Peter Edmunds, William Miller, Caroline Rogers, Leslie Henderson	First of its kind dataset on coral attributes in the USVI to understand gradients of diversity.
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.	Database of marine disease incidence completed at 42 long-term coral reef monitoring sites.				Marilyn Brandt, Tyler Smith, Rosmin Ennis	A comprehensive description of disease incidence in the USVI. Provides a foundation for understanding disease impacts at all long-term monitoring sites.

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.	Database of invasive species completed. Manuscript on the spatio-temporal patterns of Ramicrusta and peyssonnelia algal crusts at 42 long-term coral reef monitoring sites.	Manuscript on lionfish temporal changes and impacts inside and outside marine protected areas.			Tyler Smith, Rosmin Ennis, Sarah Heidmann, Richard Nemeth	An understanding of the distribution of key invasive species in the US Virgin Islands. For lionfish, its predation may skew trophic structure of key fish groups (e.g., parrotfish) that could impact coral resilience by increasing macroalgal abundance and coral-algal competition (space preemption, space monopolization, recruitment limitation of coral, coral disease). For *Ramicrusta* its occurrence suggests areas of high coral-algal competition.

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.	Determination made of how to measure this level of diversity. Database of non-coral sessile and motile invertebrates at long-term sites potentially completed completed.				Tyler Smith, Paul Sikkel, Steve Ratchford, Edwin Cruz Rivera	Understanding of how to measure diversity of more cryptic organisms.
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.	Database of diversity at 42 long-term coral reef monitoring sites completed. Analysis of site groupings using multivariate statistics to provide background material for understanding attributes of 42 long-term coral reef monitoring sites.				Richard Nemeth, Sarah Heidmann, Elizabeth Kadison	Database of USVI fish communities.

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.	Produce final metrics, a model of herbivore pressure based on diversity, size, and biomass of herbivores, and database of herbivore pressure.				Richard Nemeth, Tyler Smith, student RA	Dataset. Possible manuscript on herbivory and impacts at monitoring sites.
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.	Estimate levels of protections and vulnerability to fishing and physical damage at each site. Produce final metrics, complete database of management effectiveness.				Leslie Henderson, Caroline Pott, Caroline Rogers, Jeff Miller, Zandy Hillis-Starr, Clayton Pollock, and DPNR Coral Liaison	Dataset on management regimes and ranking of effectiveness.
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.	Produce final metrics/model runs to assign network placement for 42 long-term coral reef monitoring sites and spatially randomized sites in Goal 2.				Daniel Holstein, Marilyn Brandt, Tyler Smith	A deeper understanding of connectivity among USVI coral reefs habitats.

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	Produce final metrics and database at 42 long-term coral reef monitoring sites.				Jeremiah Blondeau	Rugosity estimates used to understand background physical reef structure that supports fish and invertebrate communities and is related to structure forming stony coral species and other sessile invertebrates.
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.	Produce final metrics and database at 42 long-term coral reef monitoring sites.				Rosmin Ennis, Tyler Smith	An understanding of coral health at the 42 long-term coral reef monitoring sites. Bleaching is needed for the 2005 impact assessment of resistance. Partial mortality records past impacts at monitorings sites.

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.	Produce final metrics and database at 42 long-term coral reef monitoring sites.				Rosmin Ennis, Tyler Smith	An understanding of coral interactions at the 42 long-term coral reef monitoring sites. Provides and understanding of how ecological interactions, such as competition for benthic space, contribute to resilience.
Objective CR1.3. Resilience Metrics	Specific milestones						
	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	Produce final metrics (dependent variables, responses of coral community) to be used in the analyses of resilience.				Tyler Smith, Marilyn Brandt, Daniel Holstein, Peter Edmunds	A score of resilience at each monitoring site.

Objective CR1.4. Gaps	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
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.	Collect information to address important gaps (if any).				Tyler Smith, Marilyn Brandt, Daniel Holstein, Peter Edmunds	Will identify and attempt to shore-up any data deficiencies prior to analyses.
Objective CR1.5. Analyses	**Specific milestones**					**Responsible parties**	**Outcomes**
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**		
CR1.5a: Lay out famework 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.	Finalize statistical modeling framework and finalize data sets for analyses.				Bayesian Modeler (contracted, TBD), Tyler Smith	A fully validated database of all available drivers at 42 long-term coral reef monitoring sites which can be shared freely and used in a variety of analyses on physical and ecological processes, including the coral reef resilience study. Statistical framework for analyses produced and prepared for modeling.

CR1.5b: Conduct analyses of resilience.	Prepare hiring documents for a resilience postdoctoral associate and advertise position.	Once components are assembled, conduct analysis of resilience drivers. Hire post-doc early in Y2.				Resilience Post-Doc, Bayesian Modeler, Tyler Smith	An analysis of drivers of resilience at 42 long-term coral reef monitoring sites, with identification of drivers most important to determining the level of resilience from - to +.
CR1.5c: Conduct workshop with participants to go over results of resilience analysis, identify and last tasks, and plan outputs and manuscripts.		Hold analyses review workshop with all participants to review the outcomes and prepare for outputs. (Projected: May 2022)				All	A finalized analysis of resilience and a determination of what should be included, prioritized, and emphasized in reports, press, outreach, and manuscripts.
CR1.5d: Prepare synthesis manuscript(s) on drivers of coral reef resilience.			Dovetail analyses workshop with writing workshop (May 2023) and prepare at least one manuscript on the analyses of resilience drivers in the USVI.	Manuscript publication.		All	Manuscript produced.

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.							
	Specific milestones						
Objective CR2.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
CR2.1.a: Develop model.		Use hydrodynamic model finalized in year one to parameterize a connectivity model.				Daniel Holstein	A fully parameterized connectivity model for the USVI. Parameterized with characteristics of stony corals larval functional attributes.
	Specific milestones						
Objective CR2.2	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
CR2.2.a: Determine network patterns.		Run model across sites with known biodiversity metrics.				Daniel Holstein, Sarah Groves, and student	A set of network attributes for sites with known biodiversity metrics (TCRMP, NPS, Edmunds, NCRMP, DCRMP).

Objective CR2.3	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
CR2.3.a: Combine biophysical data sets and connectivity analysis to see if connectivity is related to diversity.			Analysis and manuscript writing.	Manuscript publication.		Daniel Holstein, Tyler Smith, Rosmin Ennis, Sarah Heidmann, Sarah Groves (NOAA)	An analysis to determine if biodiversity is related to connectivity patterns.
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	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	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.	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.	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.	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.	Smith, Holstein, Resilience Post-Doc	Coral reef resilience research shared to a wide audience and public becomes aware of issues with coral reefs and factors affecting resilience and the long-term health and maintenance of coral reefs in the USVI and Caribbean.

CR3.1b: Share research through community outreach events (e.g., Reef Fest, Sip N' Science).	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Participate in 1 event every other year.	Smith, Holstein, Resilience Post-Doc	Coral reef resilience research shared to a local audience and an engaged sector of the public becomes aware of issues with coral reefs and factors affecting resilience and the long-term health and maintenance of coral reefs in the USVI and Caribbean.
CR3.1c: Integration Activity: EPSCoR website development.	Review, advise & inform new content on viepscor.org website to accurately reflect R2R goals and achievements.		Integrate new results from coral resilience study into website information.	Integrate new results from coral connectivity and biodiversity study into website information.		Smith, Holstein, Resilience Post-Doc	EPSCoR Website developed.
CR3.1d: Integration Activity: Annual EPSCoR Newsletter Development.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Assist communication department with relevant content for annual VI-EPSCoR newsletter. This includes providing photographs, essays, quotes, etc.	Smith, Holstein, Resilience Post-Doc	EPSCoR Newsletter developed.

Education and Workforce Development

VI-EPSCoR's Education and Workforce Development (EWFD) Team is committed to building capacity and preparing USVI K-12 students with the skills to be effective members of the Territory's future workforce, including some who will be tasked with addressing the environmental challenges facing the islands. Transforming STEM education in the USVI to be more grounded within the local environmental context will require increased engagement from both stakeholders and the EWFD, and more encouraging of community action. The EWFD Team will enhance their existing professional development model by implementing a series of interventions to build a STEM community dedicated to developing and implementing research-based best practices in teacher development, and increased student learning using environmental resilience research with a strong local context.

Goal WF1

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. The R2R research areas provide a rich variety of locally relevant topics for introduction and exploration in the K-12 classrooms in the Territory. Many of the public school teachers do not have access to the most current scientific findings and discoveries, so they welcome the support from UVI and the R2R teams to complement their curricula. The EWFD Team will build a 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. The Team will also build long-lasting STEM community partnerships for increased sustainability of the VI-ISERP center.

Goal WF2

Increase recruitment, retention, and persistence of URM undergraduates in STEM and resilience-related majors, minors, and certificate programs. The Territory needs STEM educated workers to both diversify the economy and to help address the chronic environmental challenges that are increasing in frequency and impact. Such efforts begin with keeping students engaged and successful as they complete their education. The EWFD Team will 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%. The team will also 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.

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. Successful engagement of today's students requires more than a student's interest and a good teacher. Infrastructure that supports both students and teachers, provides training and internships, experiential learning and opportunities to apply knowledge in the real world are key to developing the STEM workforce for the Territory. The EWFD Team will develop mechanisms of support and development for STEM students (undergraduate and graduate) for career skill development, research productivity, and retention. They will also develop mechanisms of support and development for early-career STEM faculty for career skill development, research productivity, and retention.

The impacts of the EWFD research through the application of a variety of tools, projects based on R2R themes, and engagement activities, the research will characterize and quantify improvements in STEM teacher preparation and student engagement that are expected to facilitate stronger science identities in URM K-16 students across the Territory.

EWFD (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							
	Specific milestones					Responsible	
Objective WF 1.1	Year 1	Year 2	Year 3	Year 4	Year 5	parties	Outcomes
WF 1.1a: Facilitate a series of annual Summer Teacher Workshops for K-12 educators	One meeting held with VIDE, needs assessment with teachers and R2R faculty for workshop themes, summer workshops for 50 educators.	One meeting held with VIDE, needs assessment with teachers and R2R faculty for workshop themes, summer workshops for 50 educators.	One meeting held with VIDE, needs assessment with teachers and R2R faculty for workshop themes, summer workshops for 50 educators.	One meeting held with VIDE, needs assessment with teachers and R2R faculty for workshop themes, summer workshops for 50 educators.	One meeting held with VIDE, needs assessment with teachers and R2R faculty for workshop themes, summer workshops for 50 educators.	C. Plyley, N. Monrose Mills.	Increases in teacher STEM efficacy and STEM engagement.
WF 1.1b: Initiate SI PBL-Certificate program to serve as structure for developing and maintaining enhanced PLCs.	Design curriculum, create program website.	Enroll first cohort (N=8), secure two R2R/UVI faculty to mentor PLCs. Teachers design 2 PBL/ R2R projects.	First cohort implements PBL projects. R2R faculty facilitates experiential learning experiences for cohort 1. Second cohort (N=7) repeats Year 2 experience.	Second cohort implements PBL projects. R2R faculty facilitates experiential learning experiences for cohort 2. Third cohort (N=7) repeats Year 2 experience. R2R faculty maintains first cohort mentorship.	Culminating event held. 10 teachers present.	C. Plyley, N. Monrose Mills.	Research and practice will boost teacher's STEM efficacy/ engagment and student's STEM identity through a research enhanced PLC model.

WF 1.1d: Conduct formative evaluation on PD Program Structure.	Five virtual workshops conducted for the academic year, over 250 hours of PD certificates granted. Assessment and evaluation conducted.	Six virtual workshops conducted during the academic year, over 300 hours of PD certificates granted. Assessment and evaluation conducted.	Six virtual workshops conducted during the academic year, over 300 hours of PD certificates granted. Assessment and evaluation conducted.	Six virtual workshops conducted during the academic year, over 300 hours of PD certificates granted. Assessment and evaluation conducted.	Six virtual workshops conducted during the academic year, over 300 hours of PD certificates granted. Assessment and evaluation conducted.	C. Plyley, N. Monrose Mills.	Teachers will evidence increases in STEM content and pedagogical knowledge and TPACK.
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.	Hire 2 student workers (new or returning).	Hire 2 student workers (new or returning).	Hire 2 student workers (new or returning).	Hire 2 student workers (new or returning).	C. Plyley, N. Monrose Mills.	Undergraduate students will trained, and mentored by VI-ISERP staff and faculty in research methodology.
	Specific milestones					Responsible parties	Outcomes/ Impacts
Objective WF 1.2	Year 1	Year 2	Year 3	Year 4	Year 5		
WF1.2a: Initiate SI PBL-Certificate program as structure for enhanced PLCs.	Create protocols for community partnerships/ begin to foster relationships.	Facilitate training on community partner protocol, create two new community partnerships.	Facilitate training on community partner protocol, create two new community partnerships.	Maintain four community partners.	Maintain four community partners.	C. Plyley, N. Monrose Mills,.	VI-ISERP will develop program sustainability through establishing long-lasting and mutually beneficial community/ university/school partnerships.

WF1.2b: Hire two Master Teachers to mentor teachers in certificate program and manage community partnerships	Create contract, job description, outline expectations, advertise positions.	Hire two candidates, one on each island.				C. Plyley, N. Monrose Mills.	PLCs and projects activities will be enhanced by pedegological expertise of Master Teachers.
WF1.2c: Facilitate culmination event with community partners	Design a culminition plan to incorporate community partners		Start planning culmination event with community partners to broaden audience.		Host culmination event with community partners. Local dissemination opportunity for teachers.	C. Plyley, N. Monrose Mills.	Project products will be shared with a larger base of stakeholders and CBOs to solidify collaboration.
WF1.2d: Establish a Stakeholder Network.	Identify relevant stakeholders for the VI-ISERP stakeholder network.	Annual Center Newsletter and stakeholder meeting.	Annual Center Newsletter and stakeholder meeting.	Annual Center Newsletter and stakeholder meeting.	Annual Center Newsletter and stakeholder meeting.	Plyley, Monrose Mills, Cummings.	There will be an increase in the VI-ISERP collaborative network with R2R faculty and community partners and documentation or project progrss and outcomes.

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.							
	Specific milestones					Responsible parties	Outcomes/ Impacts
Objective WF 2.1	Year 1	Year 2	Year 3	Year 4	Year 5		
WF2.1a: Develop and implement service learning (SL) within freshman-level courses (SCI 100 & SSC 100).	Analyze existing data from SCI 100 (2018-2020); Develop SSC 100 course with service learning.	Establish complementary learning outcomes and assessments across SCI 100 / SSC 100. Implement SL in both courses each semester (Years 2-5).	Analyze quantitative & qualitative data from Years 1 and 2 (SCI 100, SSC 100). Disseminate findings (1-2 presentations/ publications). Apply to 2-3 external funding sources.	Ongoing data analysis (Year 3). Identify and apply to 2-3 external funding sources.	Final data analysis (Year 4). Disseminate findings (2-3 presentations/ publications). Secure 1 source of external funding.	Guannel, Jaeger, UVI student researchers, Perry, Clavier.	Standardize service learning offerings to increase participation from students

WF2.1b: Evaluate 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).	Run two sets of focus groups: 1) SL participants (one focus group per semester & course; 2018-2021) and 2) service partners (one focus group for each of SCI 100 & SSC 100) to gather data on outcomes and impacts to date.	Follow-up focus groups and new focus groups for Year 2. Preliminary analysis of retention & persistence of SL participants. Adapt approaches for Years 4 & 5.	Follow-up focus groups and new focus groups for Year 3. Draft 2 papers/ presentations on focus group data.	Submit 2 publications on the service learning process for students and partners from focus group data.	Jaeger, Guannel, Perry.	Significant increase in STEM & resilience pathway retention, persistence, and graduation, for SL & RL participants relative to students who did not participate in these programs; identification of barriers and opportunities for students to take these pathways.
	Specific milestones					Person(s) responsible	Outcomes/ impacts
Objective WF 2.2	Year 1	Year 2	Year 3	Year 4	Year 5		
WF2.2a: Develop and implement a Resilience Leaders (RL) program.	Investigate structures for resilience leaders program. Identify employment and schooling goals for RL program.	Recruit former SL participants for Cohort 1 of RL internships. Pursue selected option to institutionalize RL program at UVI.	Integrate Cohort 2 (twice the number of Cohort 1). Draft manuscript of RL creation process. Submit 1-2 proposals for external funding for RL.	Integrate Cohort 3 - for minimum of 25% of SL students (~50 students completed SL & RL activities). Formal integration of RL program into UVI curriculum. Submit 1-2 proposals for external funding for RL.	Complete 1-3 presentations/ publications. Placements of majority of RL students into resilience-related jobs, internships, graduate schooling.	Guannel, Jaeger, Perry, Clavier.	Established the Resilience Leaders program at UVI to boost STEM skill development and career placement.

WF2.2b: Assess impact of RL program participation on student retention, persistence, and career goals.			Utilize Institutional Research data and yr 1-2 focus groups (from Cohort 1 split by natural/social science or semester) to assess impacts of RL program on students' academic pathways, retention, and persistence.	Utilize Institutional Research data and yr 3-4 focus groups (Cohorts 1 & 2) to assess impacts of RL program on students' academic pathways, retention, and persistence.	Summative assessment of retention, persistence, and job placement in Years 4-5. Conduct comparitive analysis (Institutional Research data across and within disciplines)	Jaeger, Guannel, Institutional Research Group at UVI	Established program for Resilience Leaders at UVI to increase student retention, persistence, and STEM 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					Responsible parties	Outcomes/ Impacts
	Year 1	Year 2	Year 3	Year 4	Year 5		
WF3.1a: Support Faculty Mentoring Training/ Mentoring Workshops.	Completion of Professional Mentor Training by 2 UVI Faculty.	Completion of Professional Mentor Training by 2 UVI Faculty. Facilitation of 1 Mentoring Workshop by Trained Facilitators.	Facilitation of 2 Mentoring Workshop by Trained Facilitators	Facilitation of 2 Mentoring Workshop by Trained Facilitators	Facilitation of 2 Mentoring Workshop by Trained Facilitators	McSween and Cummings.	Increase in the number of certified mentors to extend vetted training to faculty, establishment of a stronger mentoring culture, and professional development opportunities for faculty.
WF3.1b: Promote use of Undergraduate Student Mentoring Individual Development Plans (IDPs).	Completed review of student IDP/compact resources Adoption of IDP/ compact.	Ten STEM faculty trained for IDP/compact. Launch of IDP/ compact with 20 STEM student mentees/ End-of-year assessment. Launch of End-of Semester Surveys with 20 STEM student mentees.	Increased use of IDP/compacts with STEM mentees by 20% (N=24)/ End-of-year assessment. -End-of Semester Surveys with STEM student mentees (N=24).	Increased use of IDP/compacts with STEM mentees by 10% (N=27)/ End-of-year assessments. End-of Semester Surveys with STEM student mentees (N=27).	Increased use of IDP/compacts with STEM mentees by 10% (N=30)/ End-of-year assessment. End-of Semester Surveys with STEM student mentees (N=30).	McSween and Cummings	Increased standardization of STEM student mentoring practice, participation of UVI mentors in mentoring best practices, and consistent tracking of student matriculation, retention, and STEM skill development.

WF3.1c: Promote R2R research exposure and the use of STEM skills within an education context through an undergraduate practicum program.	Establish school practicum site. Develop student selection and supervision protocol. Recruit VI-ISERP teachers with R2R focused PBLs.	Assign students to 2 practicum slots with VI-ISERP teachers. Provide mentoring training to teachers.	Assign students to 5 practicum slots with VI-ISERP teachers. Provide mentoring training to teachers.	Assign students to 7 practicum slots with VI-ISERP teachers. Provide mentoring training to teachers.	Assign students to 10 practicum slots with VI-ISERP teachers. Provide mentoring training to teachers.	Cummings, Monrose-Mills, Plyley.	School practicum sites established where UG students can use STEM skill in the classroom.
WF3.1d: Develop a Graduate Student Professional Development Plan (PDP)/ Listserv.	Best practices in PDP researched/ PDP form designed and launched in Spring 2022. Increased STEM graduate student use of PDPs by 20% (N=8). Listserv for Grad student Professional Development launched.	Increased STEM graduate student use of PDPs by 10% (N=9) Listserv for Grad student Professional Development maintained.	Increased STEM graduate student use of PDPs by 10% (N=10). Listserv for Grad student Professional Development maintained.	Increased STEM graduate student use of PDPs by 10% (N=11). Listserv for Grad student Professional Development maintained.	Increased STEM graduate student use of PDPs by 10% (N=12). Listserv for Grad student Professional Development maintained.	McSween and Cummings	Increased standardization of graduate student professional skill development/ tracking, use of professional development tools, and accessibility to Professional Development opportunities.
WF3.1e: Establish an Integrative Student Support Network (ISSN).	Identify UVI STEM student retention and success stakeholder recruitment.	Annual stakeholder meeting for Integrative Student Support Network (ISSN) facilitated.	Annual ISSN meeting facilitated.	Annual ISSN meeting facilitated.	Annual ISSN meeting facilitated.	McSween and Cummings	Creation of network to foster STEM Student Success and EWFD sustainability.

Objective WF 3.2	Specific Milestones					Responsible parties	Outcomes/ Impacts
	Year 1	Year 2	Year 3	Year 4	Year 5		
WF3.2a: Support of Early Career STEM Faculty.	Development of annual tracking plan for early career STEM faculty. Listserv for Early Career STEM Faculty Professional Development launched.	Annual compilation of Tracking data completed. Listserv for Early Career STEM Faculty Professional Development maintained.	Annual compilation of Tracking data completed. Listserv for Early Career STEM Faculty Professional Development maintained.	Annual compilation of Tracking data completed. Listserv for Early Career STEM Faculty Professional Development maintained.	Annual compilation of Tracking data completed. Listserv for Early Career STEM Faculty Professional Development maintained.	McSween and Cummings	Consistent tracking of Early Career retention and use of mentoring structures and access to Professional Development opportunities.
WF3.2b: Support Educational Research among Early Career STEM Faculty.	Mini-grant RFP released and application review committee formed.	Two $2000 mini-grant awarded. Mini-grant RFP for Year 3 released.	Two $2000 mini-grant awarded. Mini-grant RFP for Year 4 released.	Two $2000 mini-grant awarded. Writing workshop for publications/ proposals (yr 2-3 awardees).	Writing workshop for publications/ proposals (yr 3-4 awardees).	McSween and Cummings	Increased faculty research productivity, participation in professional development opportunities, and publications and proposals.

Informal Learning

The goal of the Informal Learning (IL) Team is to continue building upon the comprehensive and culturally responsive Education and Outreach plan that will expand to be more inclusive of underrepresented minorities (URMs) within the Virgin Islands. In addition, IL will increase the scope of external partners and collaborations with other universities/research entities.

Goal IL1

Increase and sustain the reach of the Informal Learning team throughout the Territory. The IL Team will Re-establish IL on the island of St.Croix as well equalize distribution of engagement efforts between St. Thomas and St. John. The IL Team will also increase support staff or personnel to aid in outreach and/or citizen science efforts.

Goal IL2

Diversify range of topics presented in informal education and outreach initiatives. The IL Team will collaborate and communicate closely with R2R researchers, as well as 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.

Goal IL3

Promote and guide K-12 URM students into the Geosciences and broader STEM pipeline to build a local STEM workforce. The IL Team will increase and promote STEM enrichment and exposure opportunities for k-12 students. The Team will support existing STEM enrichment and/or professional development initiatives through new and existing partnerships.

Goal IL4

Work to become a recognized Hub of information and resources for STEM and environmental education, awareness and sustainability in largely underserved communities. The IL Team will become a resource locally and nationally for culturally relevant research that can benefit and assist other universities, stakeholder and partners. They will also identify avenues through which the IL Team can effectively share the current and ongoing work that has been done ("share our story").

Goal IL5

Build new and improved-upon existing connections and lines of communication to better reach and understand target audiences. The IL Team will create and utilize culturally responsive assessment tools and surveys to assess their audiences.

Goal IL6

Build self-sufficiency and innovation within the IL team and its efforts. The IL Team will pursue funding that puts the IL team in a position to be more independent in building out and promoting its initiatives. They will, through partnerships and collaborations, source and/or develop tools that innovate both real and virtual education and outreach efforts.

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.							
	Specific milestones						
Objective IL1.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
IL1.1a: Hire Community Engagement Specialist (CES) for St. Croix district.	CES hired for STX district. STX CES trained and familiarized with goals and objectives for IL and R2R.	STX CES will coordinate and participate in 2 outreach initiatives in the STT/STJ district and coordinate a minimum of 2 outreach initiatives in STX district. Identify and meet with a minimum of 2 new, or existing, partners and/or stakeholders relevant to the STX district.	STX CES will identify and meet with 2 new partners and stakeholders relevant to the STX district and coordinate 2 outreach or science communication events representative of the particular geographic, cultural and community characteristics od STX.	STX CES will identify and meet with 2 new partners and stakeholders relevant to the STX district and coordinate 2 outreach or science communication events.	STX CES will identify and meet with 2 new partners and stakeholders relevant to the STX district and coordinate 2 outreach or science communication events.	Jarvon Stout, Liza Margolis, STX CES hire.	STX-based CES is trained, thus increasing IL team's presence and impact throughout the Territory.
IL.1.1b: Creation of IL orientation and training resources.	Create a living comprehensive orientation document that details all information pertaining to IL and its initiatives.	Add a minimum of 2 new resources (partnerships, initiatives, professional development opportunities etc.) to this document.	Add a minimum of 2 new resources (partnerships, initiatives, professional development opportunities etc.) to this document.	Add a minimum of 2 new resources (partnerships, initiatives, professional development opportunities etc.) to this document.	Add a minimum of 2 new resources (partnerships, initiatives, professional development opportunities etc.) to this document.	Jarvon Stout, Liza Margolis, STX CES hire	Orientation guide is resource for familarizing current and incoming full-time, part-time and volunteer personnel to IL iniatives.

Objective IL1.2	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
IL1.2a: Equal distribution of STT/STJ engagement.	Identify and engage partners, stakeholders who will support activities and initiatives of IL.	Coordinate a minimum of 3 outreach and/or citizen science initiatives across the territory, one on each island, STT, STX and STJ.	Coordinate a minimum of 3 outreach and/or citizen science initiatives across the territory, one on each island, STT, STX and STJ.	Coordinate a minimum of 3 outreach and/or citizen science initiatives across the territory, one on each island, STT, STX and STJ.	Coordinate a minimum of 3 outreach and/or citizen science initiatives across the territory, one on each island, STT, STX and STJ.	Jarvon Stout, Liza Margolis, STX CES hire	Outreach throughout the territory will create a greater affinity to science through citizen science activities.
Objective IL1.3	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
IL1.3a: Community Partner Recruitment.	Identify groups,organizations and funding sources necessary for hiring and/or recruitment of support personnel.	Secure funding for 1 part-time graduate or undergraduate student in each district, in addition to recruiting 2 Volunteer groups for outreach and/or citizen science activities.	Secure funding for 1 part-time graduate or undergraduate student in each district, in addition to recruiting 2 Volunteer groups for outreach and/or citizen science activities.	Secure funding for 2 part-time graduate or undergraduate student in each district, in addition to recruiting 2 Volunteer groups for outreach and/or citizen science activities.	Secure funding for 2 part-time graduate or undergraduate student in each district, in addition to recruiting 2 Volunteer groups for outreach and/or citizen science activities.	Jarvon Stout, Liza Margolis, STX CES hire	This will help develop a consistent and dependable support base for the IL activities and initiatives.

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.							
	Specific milestones						
Objective IL2.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	Collaborate with research team to coordinate 1 outreach and/or citizen science initiative for each R2R theme.	Collaborate with research team to coordinate 1 outreach and/or citizen science initiative for each R2R theme.	Collaborate with research team to coordinate 1 outreach and/or citizen science initiative for each R2R theme.	Collaborate with research team to coordinate 1 outreach and/or citizen science initiative for each R2R theme.	Jarvon Stout, Liza Margolis,STX CES hire	R2R research components are adequately highlighted and represented in outreach and disseminations efforts, supporting the benefits of research and increasing community involvement.
IL2.1b Outreach menu.	Create a comprehensive document that outlines outreach opportunities by type and date, to secure researcher involvement.	Recirculate the document to give researchers a chance to secure their involvement for that academic year period.	Recirculate the document to give researchers a chance to secure their involvement for that academic year period.	Recirculate the document to give researchers a chance to secure their involvement for that academic year period.	Recirculate the document to give researchers a chance to secure their involvement for that academic year period.	Jarvon Stout, Liza Margolis, STX CES hire	Document aids in planning and outreach activities for the year.

Objective IL2.2	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
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.	Meet and form partnerships with, a minimum of 2 organizations and/or community group(s) whose work aligns with R2R research and/or dissemination efforts.	Meet and form partnerships with, a minimum of 2 organization and/ or community group(s) whose work aligns with R2R research and/or dissemination efforts.	Meet and form partnerships with, a minimum of 2 organization and/ or community group(s) whose work aligns with R2R research and/or dissemination efforts.	Meet and form partnerships with, a minimum of 3 organization and/ or community group(s) whose work aligns with R2R research and/or dissemination efforts.	Jarvon Stout, Liza Margolis, STX CES hire	Partnerships and/ or collaborative efforts created with community groups/ organizations that compliment R2R research and goals.
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					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
IL3.1a: Exposure and Engagement.	Conduct 2 STEM/ environmental science-focused outreach activities. 50 k-12 students engaged.	Conduct 4 STEM/ environmental science-focused outreach activities. 100 k-12 students engaged.	Conduct 6 STEM/ environmental science-focused outreach activities. 200 k-12 students engaged.	Conduct 6 STEM/ environmental science-focused outreach activities. 200 k-12 students engaged	Conduct 6 STEM/ environmental science-focused outreach activities. 200 k-12 students engaged.	Jarvon Stout, Liza Margolis, STX CES hire.	Increased knowledge of, exposure to, as well as interest and affinity for Geoscience, and other STEM fields, in local k-12 students.

Objective IL3.2	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
IL3.2a: STEM Support.	Support 1 STEM enrichment or professional development initiative for k-12 students and/or educators.	Support 2 STEM enrichment or professional development initiatives for k-12 students and/or educators.	Support 2 STEM enrichment or professional development initiatives for k-12 students and/or educators.	Support 2 STEM enrichment or professional development initiatives for k-12 students and/or educators.	Support 2 STEM enrichment or professional development initiatives for k-12 students and/or educators.	Jarvon Stout, Liza Margolis, STX CES hire	Provide support that leads to increased reach and sustainability for existing Geoscience, and other STEM-based, enrichment and/or professional development programs.
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").							
Objective IL4.1	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
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.	Working in conjunction with the communications coordinator, research updates will be disseminated to partners and collaborators. 1 webinar will be held with partners to discuss ideas and shared resources.	Working in conjunction with the communications coordinator, research updates will be disseminated to partners and collaborators. 1 webinar will be held with partners to discuss ideas and shared resources.	Working in conjunction with the communications coordinator, research updates will be disseminated to partners and collaborators. 1 webinar will be held with partners to discuss ideas and shared resources.	Working in conjunction with the communications coordinator, research updates will be disseminated to partners and collaborators. 1 webinar will be held with partners to discuss ideas and shared resources.	Liza Margolis, Jarvon Stout, STX CES hire	Through communication and collaboration efforts, R2R research will be acknowledged and utilized to assist partners and other jurisdictions in their research.

Objective IL4.2	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
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.	Information/ products will be shared via 1 workshop, webinar, conference or peer-reviewed publication.	Information/ products will be shared via 1 workshop, webinar, conference or peer-reviewed publication.	Information/ products will be shared via 1 workshop, webinar, conference or peer-reviewed publication.	Information/ products will be shared via 1 workshop, webinar, conference or peer-reviewed publication.	Liza Margolis, Jarvon Stout, STX CES hire.	Effective, widespread dissemination of information and products that detail the work done through R2R will create local and national awareness.
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.	Strengthen and increase communication and engagement with EOD and IL groups from other EPSCoR jurisdictions as well as EOD Council.	Strengthen and increase communication and engagement with EOD and IL groups from other EPSCoR jurisdictions as well as EOD Council.	Strengthen and increase communication and engagement with EOD and IL groups from other EPSCoR jurisdictions as well as EOD Council.	Strengthen and increase communication and engagement with EOD and IL groups from other EPSCoR jurisdictions as well as EOD Council.	Liza Margolis, Jarvon Stout, STX CES hire.	Increased communication and collaboration with other EOD and IL teams will increase the capacity of our work and programs.

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 to assess their audiences.							
	Specific milestones						
Objective IL5.1	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	Engage 2 underserved community groups through R2R-focused outreach. Disseminate surveys to gauge efficacy and impact of outreach methods with underserved audiences.	Engage 2 underserved community groups through R2R-focused outreach. Disseminate surveys to gauge efficacy and impact of outreach methods with underserved audiences.	Engage 2 underserved community groups through R2R-focused outreach. Disseminate surveys to gauge efficacy and impact of outreach methods with underserved audiences.	Engage 2 underserved community groups through R2R-focused outreach. Disseminate surveys to gauge efficacy and impact of outreach methods with underserved audiences.	Jarvon Stout, Liza Margolis, STX CES hire.	IL will be better equipped to effectively engage, educate and include the various community groups and sectors within the USVI territory.

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.							
	Specific milestones					Responsible	
Objective IL6.1	Year 1	Year 2	Year 3	Year 4	Year 5	parties	Outcomes
IL6.1a: Funding.	Successfully submit for AISL grant. Identify and cultivate 1-2 funding sources.	Identify and cultivate 2-3 funding sources.	Identify and cultivate 2-3 funding sources.	Identify and cultivate 2-3 funding sources.	Identify and cultivate 2-3 funding sources.	Jarvon Stout, Liza Margolis, STX CES hire.	IL pursues, and acquires, funding that put it in a position to be more independent in growing, improving and promoting its initiatives.
	Specific milestones					Responsible	
Objective IL6.2	Year 1	Year 2	Year 3	Year 4	Year 5	parties	Outcomes
IL6.2a: Acquisition of tools and resources.	Conduct research on viable, innovative outreach tools and strategies.	Create or obtain 2 new outreach tools/resources that can be adapted for the IL team's outreach initiatives/ activities.	Create or obtain 2 new outreach tools/resources that can be adapted for the IL team's outreach initiatives/ activities.	Create or obtain 2 new outreach tools/resources that can be adapted for the IL team's outreach initiatives/ activities.	Create or obtain 2 new outreach tools/resources that can be adapted for the IL team's outreach initiatives/ activities.	Jarvon Stout, Liza Margolis, STX CES hire.	IL creates or obtains resources that help to innovate and improve outreach, science communication and citizen science efforts.

Communication and Dissemination

The R2R team's mission of advancing science-informed knowledge of the impacts of environmental disturbances stemming from climate change and land use practices in the US Virgin Islands will be achieved in a number of time-tested ways. A cornerstone of our communication strategy will be the website (vi epscor.org) which will be updated regularly to reflect ongoing R2R achievements and opportunities for community engagement. Also essential is connecting directly with the community via social media. These outlets include Instagram, Facebook and Twitter. YouTube will be used for far-reaching informal learning and education. In addition, a bi-annual newsletter will be published featuring the work and accomplishments of the R2R team. This newsletter will communicate science in a visually appealing and accessible way and its wide distribution has the added potential to connect with audiences who may not be digitally savvy. IL opportunities will be promoted via all of the above listed outlets thus engaging audiences territory-wide.

Goal CD1

Inform stakeholders and community of R2R Project research and educational goals and the progress made toward achieving those goals. The CD Team will update the R2R website viepscor.org; they will generate social media content; they will write blog posts; create videos for YouTube Channel, and run a photo essay series.

Goal CD2

Produce a biannual VI-EPSCoR Newsletter for broad audiences. The CD Team will gather key highlights of R2R research and activities reflecting the full range of research and educational activities for the newsletters.

Goal CD3

Support R2R project team's promotional needs. The CD Team will create flyers, social media posts and other promotional materials as needed to promote events and activities. They will also provide visual support for researcher and student projects.

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							
	Specific milestones					Responsible parties	Outcomes
Objective CD1.1	Year 1	Year 2	Year 3	Year 4	Year 5		
CD1.1a: Update website viepscor.org	Update viepscor.org site with R2R goals.	Review site once per year and update as needed.	Review site once per year and update as needed.	Review site once per year and update as needed.	Review site once per year and update as needed.	E Lacatena, Administration, Research/Project Leads.	viepscor.org reflects project goals and team accomplishments
	Specific milestones					Responsible parties	Outcomes
Objective CD1.2	Year 1	Year 2	Year 3	Year 4	Year 5		
CD1.2a: Generate social media content	Post content to social media outlets, a minimum of once per week.	Post content to social media outlets, a minimum of once per week.	Post content to social media outlets, a minimum of once per week.	Post content to social media outlets, a minimum of once per week.	Post content to social media outlets, a minimum of once per week.	E Lacatena	Community is informed of project accomplishments and activities.
	Specific milestones						Outcomes
Objective CD1.3	Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	
CD1.3a: Write blog posts	Write 2 blog posts reflecting R2R Project activities and/or accomplishments.	Write 2 blog posts reflecting R2R Project activities and/or accomplishments.	Write 2 blog posts reflecting R2R Project activities and/or accomplishments.	Write 2 blog posts reflecting R2R Project activities and/or accomplishments.	Write 2 blog posts reflecting R2R Project activities and/or accomplishments.	E Lacatena	Community is informed of project accomplishments and activities.

Objective CD1.4	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
CD1.4a: Create videos for YouTube Channel		Create one video for YouTube channel.	Create one video for YouTube channel.	Create one video for YouTube channel.	Create one video for YouTube channel.	E Lacatena	Videos reflect Project goals resulting in greater community awareness and understanding of the project.
Objective CD1.5	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
CD1.5a: Create photo essay reflecting project goals.	Write and photograph one essay reflecting R2R project goals. Publish the essays on the blog and promote on social media.					E Lacatena	Community is informed of project accomplishments and activities.
Goal CD2: Produce a biannual VI EPSCoR Newsletter. · Objective 2.1: Produce two newsletters per year.							
Objective CD2.1	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
CD2.1a: Produce newsletter reflecting Project accomplishments, activities and goals	Write and publish one newsletter in Spring/Summer 2021.	Write and publish two newsletters, one Fall/Winter and one Spring/ Summer.	Write and publish two newsletters, one Fall/Winter and one Spring/ Summer.	Write and publish two newsletters, one Fall/Winter and one Spring/ Summer.	Write and publish two newsletters, one Fall/Winter and one Spring/ Summer.	E Lacatena, Administration, Research/Project Leads.	Newsletters are distributed digitally and in print and feature the research and activities of R2R Project.

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. · Objective CD3.2: Provide visual support for researcher and student projects.							
	Specific milestones					Responsible parties	
Objective CD3.1	Year 1	Year 2	Year 3	Year 4	Year 5		Outcomes
Objective CD3.1: Create flyers, social media posts and other promotional materials as needed to promote events and activities.	10 hours per month dedicated to designing materials (flyers, posters, cards, t-shirts, social media posts, etc.) as needed to advertise VI-EPSCoR events.	10 hours per month dedicated to designing materials (flyers, posters, cards, t-shirts, social media posts, etc.) as needed to advertise VI-EPSCoR events.	10 hours per month dedicated to designing materials (flyers, posters, cards, t-shirts, social media posts, etc.) as needed to advertise VI-EPSCoR events.	10 hours per month dedicated to designing materials (flyers, posters, cards, t-shirts, social media posts, etc.) as needed to advertise VI-EPSCoR events.	10 hours per month dedicated to designing materials (flyers, posters, cards, t-shirts, social media posts, etc.) as needed to advertise VI-EPSCoR events.	E Lacatena	Professional promotion of activities resulting in greater awareness of VI-EPSCoR and increased participation in outreach activities.
	Specific milestones					Responsible parties	
Objective CD3.2	Year 1	Year 2	Year 3	Year 4	Year 5		Outcomes
CD3.2a: Provide visual support for researcher and student projects.	5 hours per month committed to supporting reserchers and students projects	5 hours per month committed to supporting reserchers and students projects	5 hours per month committed to supporting reserchers and students projects	5 hours per month committed to supporting reserchers and students projects	5 hours per month committed to supporting reserchers and students projects	E Lacatena, Research/Project Leads, Students	Outputs are included in grant applications, reporting and press releases, resulting in potential supplemental funding and enhanced connection with the community and partners.

Sustainability Plan

The primary goal of the R2R project is to build sustainable capacity at UVI and in the USVI to increase knowledge about the impacts of environmental disturbances stemming from climate change and land use practices in the US Virgin Islands, and, identify resources and strategies for researchers and stakeholders to mitigate those impacts. The R2R team will accomplish this in part with two new research faculty hires, one as a restoration ecologist, and the other yet to be determined, but likely a hydrologist. The EWFD initiatives will also build sustainability by providing STEM inspiration, instructuction, and capacity at levels ranging from K-12 through to undergraduates.

Long-term sustainability of the R2R effort will be realized through external funding support that range from single PI awards to larger collaborative programs. The R2R project will include both formal and informal mentoring of new faculty and grant writing and publication workshops.

Goal SP1

Increase sustainability of R2R research through new hires and applications for external funding. The R2R team leadership will provide support through writing workshops and informal mentoring for proposal development in conjunction with UVI's Office of Sponsored Programs.

Approach: Management, Evaluation and Assessment Plan

R2R will implement a thorough and responsive management structure overseen by highly qualified Leadership and Management Teams, assisted by two panels of authorities and experts. Project leaders will benefit from annual feedback from our external evaluators and from our External Advisory Board, focused on general project activities.

Management

R2R adopts a shared leadership model proven effective in large team science projects, with five Management Team members providing day-to-day management and another eight providing science and outreach leadership. The Project Director will provide strategic guidance and lead synthesis discussions.

The Project Administrator will oversee project coordination. A Financial Manager will provide financial oversight, a Communications Manager will coordinate external engagement, and a Data Specialist will lead data collection and management activities. Science leadership comes from the leads for Coastal Resilience, Emerging Areas, Fish Ecology and EWFD areas.

The Leadership and Management teams will ensure that R2R meets the goals and objectives in the Strategic Plan; respond to external evaluations and NSF Site Visit and Reverse Site Visit recommendations and implements appropriate changes; awards seed grants; and compiles NSF reports, including creating an online database to facilitate annual reporting by participants. The Management Team will oversee the management and dissemination of data and data products generated by the project, which will be stored in an R2R on-premise data repository that replicates to a cloud-based service for redundancy and made available via an online portal, both maintained by R2R's project administrator and data specialist. The Leadership and Management teams will meet monthly to coordinate progress, and will also meet with leadership teams of individual research areas monthly. Additionally, the research leads will maintain internal communication with team members.

Two different groups will offer input and oversight to the Leadership Team. VI- EPSCoR is governed by a 9-member Governing Committee, consisting of leaders from government, agencies, academia, and the private sector. UVI's President serves as Chair of the Governing Committee. The Governing Committee will annually review R2R progress and provide guidance to assure the program achieves the Territory's S&T goals.

The Leadership Team will also draw on recommendations from an External Advisory Board (EAB) consisting of outside experts in R2R fields, who will measure progress toward milestones and recommend course corrections. Members are Dr. Karl Benedict, Director of Research Data Services/ Director of IT at the University of New Mexico; Dr. Lauren Mullineaux, Senior Scientist at Woods Hole Oceanographic Institute; Dr. Betsy Gladfelter, Guest Investigator at Woods Hole Oceanographic Institute; Dr. Mark Boardman, Professor Emeritus of Miami University; Dr. Leonard Nurse, Professor Emeritus of the University of the West Indies at Cave Hill; Dr. Cecil Jennings, Adjunct Professor of Fisheries and Wildlife

at University of Georgia, and Marta Collier-Youngblood, Grants and Business Development Consultant, Youngblood and Associates, LLC. There are two EAB vacancies that will be filled within the year.

Succession Plan

R2R operates under a Succession Plan to ensure swift and orderly transitions should any Leadership Team members exit the project. Should PI/PD Waddell leave the project, a successor will be identified and approved by UVI's Provost. That individual will then be confirmed by the UVI President, pending approval by NSF EPSCoR. In the event any Co-PI's or the PA leaves their position over the course of the project, the Project Director will choose a replacement.

Evaluation and Assessment

External evaluators of the project as a whole are Drs. Kelvin Chu and Samantha Brown of The Implementation Group (TIG), serving as independent consultants. TIG will provide annual reports, including summaries of data, findings, and recommendations, which will be shared with the R2R Leadership Team and with NSF. R2R leaders will institute annual midcourse changes based on these evaluations as appropriate.

Formative and summative evaluation and assessment components will be utilized to provide feedback and assist the R2R Leadership Team in successfully achieving the proposed goals and objectives. TIG will collect quantitative data using consistent metrics for longitudinal tracking of activities and outputs, and qualitative data collection to explore and understand nuances of project work. Primary data collection will include annual interviews with R2R leadership and key faculty, analysis of project documents, observations, as well as annual surveys (including social network analysis) of faculty and/or students. Surveys will be analyzed using descriptive statistics, content analysis, and parametric statistics where appropriate. Team productivity will be assessed with bibliometric and/or extramural funding proposal data in years 2-5. Data collection and analysis will address project development, interdisciplinary collaboration, knowledge production, and related outcomes in the Watershed Monitoring and Land Use, Mangroves Ecosystem Function & Recovery and Mangrove Restoration, Fish Ecology, Oceanography, Marine Disease and Restoration, and Coral Reef Resilience teams, as well as for Emerging Areas of Research. The analysis will also take into consideration differences across program participants by career stage, institution, discipline, and other factors. Metrics will be selected to reflect development of research capacity and competitiveness.

The impacts of the external evaluation activities include the implementation of changes to the project as appropriate based on evaluations, and improving the ability of the R2R teams to meet their research and outreach goals. Consistent/regular information sharing between PI and External Evaluators as well as meeting attendance will allow for enhanced ability to make any appropriate changes based on shared data.

Goal RM1

Meeting the Data Management needs of the R2R team.

Goal RM2

Providing the R2R team with the Project Management support needed to meet their goals and objectives.

Goal RM3

Collaborating with our External Evaluation and NSF EPSCoR Program teams to meet UVI and NSF's expectations for R2R Project Evaluation and Assessment.

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.							
Objective RM1.1	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
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.	Collaborate with Florida International University (FIU) and Network Engineer Consultant to configure network speed and capacity according to research capacity needs.	Continued assessment and upgrade of Internet capacity throughput according to research data needs.	Continued assessment and upgrade of Internet capacity throughput according to research data needs.	Continued assessment and upgrade of Internet capacity throughput according to research data needs.	Kelly Harrigan, Information Technology Services, Network Engineer Consultant, FIU.	Faster and easier access to research data.
Objective RM1.2	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
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.	Develop specifications for and conduct RFP. Contract with cabling and wireless hardware vendors. Begin cabling work in STX research facility.	Continue in building cabling work on STX campus. Test, document and confirm new cable runs are successfully installed and fully functional.	Upgrade WiFi network and hardware for all research facilities.		Kelly Harrigan, Information Technology Services, Network Engineer Consultant.	Faster and easier access to research data.

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.	Develop specifications for and conduct RFP. Contract with Fiber vendor. Begin fiber work on STT campus.	Continue fiber work on both campuses. Test, document and confirm new fiber runs are successfully installed and fully functional.			Kelly Harrigan, Information Technology Services, Network Engineer Consultant.	Faster and easier access to research data.
	Specific milestones					Responsible parties	
Objective RM1.3	Year 1	Year 2	Year 3	Year 4	Year 5		Outcomes
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.	Assessed regularly in partnership with Research/Project Leads and is ongoing throughout the project.	Assessed regularly in partnership with Research/Project leads and is ongoing throughout the project.	Assessed regularly in partnership with Research/Project leads and is ongoing throughout the project.	Assessed regularly in partnership with Research/Project leads and is ongoing throughout the project.	Kelly Harrigan, Research/Project Leads.	R2R research data capacity needs are met.
	Specific milestones					Responsible parties	
Objective RM1.4	Year 1	Year 2	Year 3	Year 4	Year 5		Outcomes
RM1.4a: Deploy on-premises research virtual server and storage environment with replication to MS Azure, and possibly other public cloud environments.			Assess research current data repository capacity needs.	Procure, install and configure on-premise Virtual server and storage environment.	Configure, test replication to and from on-premise virtual server and storage to MS Azure Cloud.	Kelly Harrigan, Research/Project Leads, Information Technology Services, Network Engineer Consultant.	R2R research data is backed-up and redundant to accommodate disaster recovery.

Objective RM1.5a	Specific milestones Year 1	Year 2	Year 3	Year 4	Year 5	Responsible parties	Outcomes
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.	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.	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.	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.	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.	Research/Project Leads, Resa Berkeley.	Accurate and timely reports from Researchers which will inform the NSF annual report.

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					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
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.	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.	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.	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.	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.	Kim Waddell, Kelly Harrigan, Research/Project Leads, EAB, GC.	Overall oversight of project to ensure avenues of communication are open and of project reporting, activities and outcomes.
RM 2.2b Workshop and Annual Conference development, logistics, and coordination.	Identify workshops themes, dates, collaborators, and interdependencies.	Hold a mentoring workshop. Hold a summer teacher workshop. Hold an Annual Conference.	Hold a coral resilience workshop to analyze data sets. Hold a writing workshop. Hold a mentoring workshop. Hold a summer teacher workshop. Hold an Annual Conference.	Hold a mentoring workshop. Hold a summer teacher workshop. Hold an Annual Conference.	Hold a mentoring workshop. Hold a summer teacher workshop. Hold an Annual Conference.	Kim Waddell, Kelly Harrigan, IL, EWFD, Research/Project Leads, Elisa Lacatana, Resa Berkeley.	Successful implementation of workshop and associated activities.

Objective RM2.3 Prepare the next USVI Science and Technology Plan	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
RM2.3a: Assess, coordinate and create plan.		Identify internal and external stakeholders.	Coordinate with stakeholders to create draft plan.	Plan finalized and signed off on by UVI President and VI Governor.		Kim Waddell, Kelly Harrigan, UVI Cabinet, Governing Committee, VI Government.	A Science and Technology Plan is created to be used in the next Track 1 proposal. Territory has comprehensive plan for implementation.
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 Evalaution Objective RM3.2: External Evaluation Communication/Attendance at VI EPS Meetings							
Objective RM3.1a	Specific milestones					Responsible parties	Outcomes
	Year 1	Year 2	Year 3	Year 4	Year 5		
RM3.1a: External Evaluation	Initial planning and evaluation development/ Instruments designed/ Leadership interviews held, faculty surveyed.	Leadership and student interviews held, faculty and students surveyed, proposals and awards analyzed	Leadership, faculty, partner interviews held, students surveyed, bibliometric and proposals and awards analyses undertaken	Leadership, faculty, partner, UVI interviews held; faculty and students surveyed; proposals and awards analyzed	Leadershp, partner, UVI interviews held; students surveyed; bibliometric and proposal and award analyses undertaken	Kelvin Chu, Samantha Brown	4 external evaluator reports (Year 1 and 2 report will be combined and delivered in Year 2) Data and recommendations to R2R Leadership Team.
RM3.1b External Evaluation Communication/ Attendance at VI EPS Meetings	R2R Meeting attendance; regular/as-needed communication with PI.	R2R Meeting attendance; regular/as-needed communication with PI.	R2R Meeting attendance; regular/as-needed communication with PI.	R2R Meeting attendance; regular/as-needed communication with PI.	R2R Meeting attendance; regular/as-needed communication with PI.	Kelvin Chu, Samantha Brown	Data and recommendations to R2R Leadership Team

Risk Management Plan

The R2R Risk Mitigation Plan assesses the most likely risks that the R2R project and team faces and logical steps to prevent and alleviate them. The largest risks stem from the ongoing COVID pandemic and its disruption of traditional in-person education, research and outreach activities, and the longer term economic impacts on the USVI tourism-based economy that will reduce the USVI government's capacity to support the University. The location of the jurisdiction in the "hurricane alley" in the Northeastern Caribbean poses a seasonal disruption threat that can vary from a 2-3 day cessation of normal activities for storm preparation to a complete shutdown and national disaster declaration that impacts the entire project for years. More common risks include personnel issues, including potential attrition of key faculty or delays in hiring.

Risk Management Mitigation (RMM)				
Component	Condition	Impact	Likelihood	Mitigation
Research Component	Recruitment and Retention of faculty, collaborators and key technical staff	Medium	Low	Succession planning, early and extensive recruiting process.
	Interruption of research activities and destruction of facilities by Natural disasters	High	Low	Conduct early preliminary experiments, consult with vendors to design appropriate technology.
	Institutional and Government budget cuts delay research activities	High	High	Secure supplemental funding, negotiate IDC recovery agreement.
	Inability to perform research objectives due to lack of data	High	Low	Start workgroups on data sources earlier to identify weaknesses and areas for improvement. Identify and recruit all partners early. Conduct and early presentation on the purpose, objectives, and goals of the analyses to align participants.
	Inability to perform research due to lack of equipment and resources	High	Medium	Develop Working group with quarterly meetings, to discuss strategies, identify clear research leads with outcomes related to managing this in Year 1. Identify new proposals that include funding support for equipment and management of the data.
	Delayed reconstruction of research facilities destroyed by natural disasters	High	High	Increase communication with physical plant.
	Lack of institutional support for pre- and post-award grants management: administration, accounting	High	High	Increase communication with Administration and allocate more resrouces to grants administration as number of awards increases.
	Faculty Tenure	High	High	EPSCoR and CMES Admin in conjuction with research faculty and other research intesive units in the college like AES need to develop a strategic plan that demonstrates the importance and potential research and productivity losses, including leverage points to convince University admin. A working group within VI EPSCoR should be developed to address this.

Formal Learning	Recruitment and Retention of faculty, teachers, students and other participants	High	Medium	Strengthen program infrastructure and plan, contract-based deliverables - Educator departure-use mutiple leads to keep stable movement to outcomes/ Faculty departure- strengthen the initial planning of program structure to allow shifts in research lead or execution.
	Interruption and destruction of facilities by Disasters	High	Medium	Design a STEM Education infrastructure research plan that is highly adaptable in the event of natural disasters or COVID- 19, identify collaborators that conduct research in areas not as prone to natural disasters.
	Limited funding to complete objectives	Medium	Medium	Find alternative funding sources.
	Data collection barriers which would affect objective completion	High	Low	Find alternative ways to collect data.

Informal Learning	Lack of personnel required to assist complete Informal learning activities	High	Medium	Hiring necessary peronnel to ensure EOD representation on each island -mobilize students to support Outreach in partnership with WFD teachers to volunteer for event (PLCs).
	Lack of communication and collaboration with EPSCoR funded researchers.	Low	Low	Improve frequency and collaboration with researchers.
	Lack of dedicated building space for informal learning activities	High	High	There may be opportunities within the new CMES layout to utiize specific spaces for outreach activities/storage. We will also look into the feasibility of creating spaces that accomodate our needs.
	Disasters will prevent the activities from being completed	High	Medium	Creating avenues to reach people after a disaster.
	Lack of informal education tools required to complete objectives	High	High	Seek out additional funding and partnerships.
	In person activities restricted	High	High	Capitalizing on more distance and virtual learning platforms-Research on other juristictions approach to COVID19 threats to outreach/ Establish a communication strategy with partners to mitigate COVID19 threats on access and availibility.
	Low attendance at informal learning activities by community and student participants	High	Medium	Early and constant advertisement in locally accessible mediums of commuication. Strong partnerships and culturally relevant activities.
	Continued loss of local students over time	High	Medium	Work (with partners, educators, stakeholders etc.) to ensure that there are more impactful and competetive opportunites within the Territory that are available to local students.

Communications and Disimination	Lack of support staff and external staff to assist with completing objectives	High	Medium	Hire early career assistant / continue to mentor and partner with student interns.
	Impact of natural disasters inhibits promotional and other objectives	High	Medium	Engage SEAS fellow and student workers to assist with website and social media promotions.
	Improve collaboration and communication with research component to provide deliverables for the grant	High	High	Restructure collaboration and communication plan so that the overall objectives can be achieved.
	Social media accounts have low audience engagement/ content	Medium	Medium	EngageVI-EPSCoR social media expertise and set up web page.

R2R Management	Institutional Procurement constraints for supplies and resources needed to achieve objectives	High	High	Identify what is needed and have reasonable expectations of how long the procurement process should take; consideration of shipping and delivery times. Efficient and effective communication need to occur. Set and manage clear expectations.
	Natural disasters impede overall productivity	High	Medium	Disaster Mitigation Plan.
	Limited funding to hire personnel needed for the administrative and research components	High	High	Identify alternative sources of funding.
	Institutional and Government funds used to assist the research and administrative objectives are reduced or eradicated	High	High	Actively seek additional funding opportunities & apply to various funders to leverage NSF & UVI support.
	Unfunded external proposals used to supplement budget	Medium	Medium	Identify alternative sources of funding.
	Lack of organizational structure, protocols and clear project timelimes for the grant.	Low	High	Develop organizational chart detailing responsibilities, outcomes, and management structure.
	Clear lines of communication needs to be established between all components	Low	Medium	Improve and increase communication between components.
	Reduction in funding for resources and personnel resulting in inability to achieve objectives	High	High	Identify alternate sources for funding for personnel.

Appendix A - Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis

In July 2020, members of the individual R2R components as well as R2R leaders met independently to develop SWOT analysis for their components. These analyses were discussed and refined by component leads as a group in an July 2020 meeting and again at the August 2020 Strategic Planning Meeting.

When asked to identify strengths, many R2R faculty pointed to the experience of the researchers and management team, the interdisciplinary nature of the science and of the research teams, and the innovative approaches being applied. Major weaknesses cited included the lack of specific expert personnel in some areas; funding limitations; and concerns about the challenges of doing research in the Caribbean.

Faculty and staff noted that R2R presents opportunities to extend the depth and breadth of the research through collaboration with external organizations. They also cited opportunities to increase integration within R2R, and to enhance knowledge co-production and outreach by working with communities. Threats to R2R research came in areas including COVID, hurricanes and impacts to equipment and fieldwork plans; personnel turnover and recruitment difficulties; and unexpected changes to funding support.

Strengths

Program Management

- A seasoned management team
- Established relationships across Territory and US Mainland
- 15-year experience with NSF EPSCoR
- Opportunistic with funding and outreach
- Strong and established communication network within Territory

Watershed and Land Use Component

- Strong support from AES and School of Agriculture
- Dedicated team familiar with analytic methods and tools
- Postdoc and student support

Emerging Areas Component

- Experienced Team
- Convenient research location
- Undergraduate and graduate student support
- Existing Partnerships with foundations, VI Government agencies

Mangroves and Mangrove Restoration Component

- Shared responsibility for mangrove restoration program with VI EPSCoR and VI Marine Advisory Service
- Multiple sites
- Collaborative opportunity to develop restoration methodologies with other R2R leads
- Undergraduate and graduate student support for projects
- Products of research to benefit management of mangroves

Marine Disease and Restoration Component

- Postdoc, technician, student and grad student support for component
- Existing funding for marine disease research
- Existing boat and scuba equipment that is well maintained and serviced
- New hire for restoration component

Fish Ecology Component

- Strong experienced team
- Familiarity with sites and species
- Easy access to sites
- IACUC approval in place
- Established collaborations with other EPSCoR jurisdictions
- Positive relations with relevant Government (US & VI) for permits

Oceanography Component

- Multidisciplinary team
- QA/QC for large range of equipment
- Ongoing long term oceanographic time series data
- Strong connectivity and physical modeling infrastructure
- Student support
- Strong infrastructure of information and research opportunities for R2R team and students

Coral Resilience Component

- Strong experienced team
- Rich source of long term data
- Good modeling resources
- Established collaborations with other EPSCoR jurisdictions
- Support for students and postdoc

Education and Workforce Development Component

- Access to target audiences
- Strong relationships with other R2R team and EPSCoR jurisdictions
- Strong relationship with STEM teachers across Territory
- Experienced team
- Existing research base for planned work
- Support from UVI departments

Weaknesses

Program Management

- Limited overlap of faculty and staff skill sets due to small institutional system
- Substantial and frequent cuts to the University of the Virgin Islands budget by the Territorial Government
- Challenge of attracting diverse candidates for research faculty hires due to high cost-of-living coupled with modest salary offers
- Equipment costs are high given our remote location relative to the American supply chain

Watershed and Land Use Component

- Personnel shortages in department
- Equipment/facilities challenges
- Collaborating/communicating with multiple research teams
- Delays or problems in external lab analysis processing times for DNA microarray, sediment tracking, nutrient analysis etc.
- Randomized Intervention Analysis in land use intervention study: problems with design symmetry

Emerging Areas Component

- Limited number of support personnel

- Need to rely on student teams
- Relies on diving operations for equipment deployment, maintenance and retrieval
- Students have weak physics and mathematics backgrounds
- No coastal scientist or technician with relevant training apart from project lead
- Not enough understanding of VI coastal systems

Mangroves and Mangrove Restoration Component

- Multiple sites increases complexity of travel and logistics
- Named sites need additional permitting beyond territorial permits, which may be difficult to acquire due to proposed methods (i.e. drone surveys)
- Shared responsibility for mangrove restoration program with VI EPSCoR and VIMAS
- No travel money to present research findings at meetings
- Difficulty propagating diversity of mangrove species for restoration activities
- No clear guidance on who is leading and organizing Writing Workshops
- Lack of Internal team communication structure: how and with what frequency project teams communicate?

Marine Disease Component

- Only partial funding for key positions - relying on additional external funding
- No funding for restoration technician
- Spatial scale of research limited to St. Thomas/St. John
- Excessive demands on PI for outreach/newsletter content

Fish Ecology Component

- Certain field methods/technology remains untested
- Lack of physical infrastructure due to delayed post-hurricane reconstruction
- New collaborations with PR researchers
- Vulnerable financial situation within Institution and Jurisdiction
- Perceived lack of connection to other research areas

Oceanography Component

- Lack of clear organizational structure
- Lack of infrastructure supporting oceanographic research
- Research needs and outcomes overcommitted across several research areas
- Limited funding for support staff
- Insufficient funding levels for IT resources and Large-Oceanographic Research
- Lack of synergy and capacity among research areas relying on connectivity modeling
- Unclear responsibilities regarding oceanographic equipment management and revenue stream

Coral Resilience Component

- Leader of workshop has never planned and implemented a workshop
- No identified leader/facilitator/logistics of writing workshop
- Loss of key participant for connectivity analysis
- Not all data elements aligned

Education and Workforce Development Component

- Limited number of early career faculty to facilitate mentorship experiences
- Mentoring framework is not designed to be tiered
- Early career faculty have multiple assignments that may allow for only limited commitment to research, mentor-

ship, or the production of scholarly products
- Lack of institutional support for community placements.
- Inadequate staff on St. Thomas
- Lack of communication and collaboration with EPSCoR funded researchers.
- Inadequate communications with target audience
- Lack of dedicated space for informal learning/outreach
- Disconnect between enhanced teacher knowledge/skills and impact on students
- Team includes majority of members with caretaking responsibilities and/or health vulnerabilities
- Lack of tenure/long-term security for faculty
- Lack of a system for long term storing of information and work products to ensure viability of service learning across campuses and among faculty members

Opportunities

Program Management

- Increased integration across research areas and with IL and EWFD
- Increased visibility across the jurisdiction through enhanced communications efforts
- Partnership opportunity with UVI's new School of Agriculture

Watershed and Land Use Component

- Possible important opportunities to study major tropical storm/hurricane events
- Integration of drought into study
- Efficiencies related to COVID-19 work from home policy
- Creating collaborations with community stakeholders for on-farm, on-site experimentation
- Public awareness of land use practice connection with marine ecosystems
- Potential to attract undergraduate/graduate students interested in agroecological research to UVI

Emerging Areas Component

- New outreach opportunities and community partnerships
- Attract private donor support
- Interdisciplinary projects can attract students with broad academic backgrounds
- Hurricanes reset conditions
- Increased interest by Federal agency (NOAA) in VI coastal systems
- New PhD opportunities for UVI students through collaborating institutions
- New research areas for the USVI: high probability of publication
- Understanding what drives yearly fluctuations in Sargassum influx
- Higher integration with agriculture/land process team

Mangroves and Mangrove Restoration Component

- New hire: citizen science coordinator
- Leveraged opportunities with NSF INCLUDES SEAS Islands Alliance
- Leveraged opportunities with NSF NRT STRONG COASTS and NSF S-STEM
- New research partnerships with USGS, NPS
- Connections to EOD programming and activities
- Increased output of papers, proposals from Writing Workshops
- New office and lab facilities for use in year 2
- New science: evidence-based mangrove restoration

Marine Disease Component

- Leverage existing collaborations and funded restoration projects
- New applications of technology to restoration
- Attracting new collaborations
- Continued support of interagency/institutional body for coordinating disease response in the territory
- Partner with local researchers for joint aquaculture/restoration opportunities
- Potential for community partners to provide job training in restoration
- Leverage activities of SEAS Islands Alliance
- Collaborative permit with the territory for SCTLD research
- NPS grant to genotype corals throughout the territory

Fish Ecology Component

- Increased collaborations with researchers within US Virgin Islands
- Increased community engagement on integrated coastal ecosystems
- New knowledge on feedback loops driving coral/algal alternative stable states

Oceanography Component

- Strong interest from stakeholders and research partners to codify/develop stronger research relationships
- Opportunity to engage local community regarding Oceanographic research and data usage

Coral Resilience Component

- Diverse partners
- Development of new understanding of resilience
- Diverse data synthesis can lead to multiple research outputs (papers)
- Processed-based characterization of VI coral reef systems
- COVID-19 delay to workshop will allow leveraging of virtual meetings to get sub-groups interacting
- Increase public engagement

Education and Workforce Development Component

- Community with a large number of NGOs and governmental organizations interested and supportive of student community engagement and service learning.
- Numerous community events that dovetail with SSC 100 content priorities and offer opportunity to create public events to increase public engagement
- Community supportive of efforts to promote and preserve Caribbean cultural resources.
- Potential to increase undergraduate support and mentorship
- Increased STEM Engagement/Career Opportunities
- Emerging industries and internship opportunities
- Impetus to create visibility and build virtual structure with digital repository
- Discovery of new ways to conduct service learning and community engagement as well as expanding resilience outcomes due to COVID-19

Threats

Program Management

- Persistent COVID-19 impacts on research, education and outreach
- Failed research faculty searches/hires
- Research productivity impaired by UVI's inefficient grants management infrastructure
- Turnover and attrition in management and science teams
- Lack of cooperation or understanding between Teams
- Decrease of Territorial matching funds

Watershed and Land Use Component

- Hurricanes damages in-situ equipment and environmental monitors
- Continued COVID-19 difficulties
- Extended drought
- Land access problems
- Sudden, uncontrolled changes in upstream land use above study areas significantly changing characterization of a study site during the 5 year study period
- Loss or changes in key personnel

Emerging Areas Component

- Disease of turtles affecting behavior (i.e. fibropapillomatosis)
- Damage and loss of in-situ acoustic and other equipment due to storms
- Not enough data to make the case because wave environment too quiet
- COVID impacts travel by off-island collaborators and students
- Permits for collection take a long time
- Institutional delays for reimbursement, purchasing and payment processing
- Insufficient, inadequate or non-existent laboratory and office space for project lead or guest researchers
- Fluctuation of *Sargassum* blooms - minimal golden tide on St. Thomas

Mangroves and Mangrove Restoration Component

- COVID-19 impacts on citizen science activities; in-ability for in-person work, lack of resources and expertise for virtual engagement
- Insufficient support for maintenance of water tables; coordination of activities; potential electricity failures
- No external proposals funded to support salary for Research Lead, technician nor new hire
- Researchers, students, or participants get sick with COVID-19
- Construction delays impact already strained facilities

Marine Disease Component

- Delayed reconstruction of Marine Science Building and other facilities like EAL
- Lack of communication in reconstruction of Marine Science building leading to deficiencies in capacity to carry-out work
- Budget cuts in external funding lead to reduced funding for technician support
- UVI does not support new Restoration Ecologist hire
- External funding proposals not funded
- Hurricanes, other natural disasters affect infrastructure
- COVID-19 affects health/life of faculty, staff, students
- Lack of childcare because schools not open
- Lethal coral disease (SCTLD) eliminates majority of coral population
- Collaborators can’t accept work (e.g., I. Baums and genotyping)
- Reliability of MMSC sea water system threatens entire water table based research projects
- Lead researchers are not tenure track, no opportunity for stability or tenure
- Budget cuts lead to elimination of key personnel

Fish Ecology Component

- Interruptions of boating and diving activities due to COVID-19
- Financial implications that may result due to COVID-19
- Inability to recruit new post-doc
- Hurricanes damages in-situ acoustic array, oceanographic equipment and marine facilities
- Key personnel becomes unable to contribute to project due to illness or departs university
- Inability to recruit qualified students

- Approval of research permits for all aspects of project
- VIERS research station not available for room and board and as research base
- Research vessels not available

Oceanography Component

- Delay/Loss of complementary research from partners due to COVID-19
- Loss of necessary staff (Phys Oce Postdoc) due to Exec. order on Visas.
- Unclear timelines for Infrastructure Rebuild for CMES facilities damaged in 2017 Hurricanes
- Unsafe, and unsuitable working environment for staff and student research

Coral Resilience Component

- Key persons with data or analytical expertise named in proposal might decline to participate
- COVID-19 delays in-person workshop
- Data and models for connectivity analyses not appropriate for questions being asked
- Natural disaster such as hurricane affects planned Resilience workshop
- Budget cuts eliminate positions or key personnel

Education and Workforce Development Component

- Loss of staff/personnel
- Major hurricanes damaging island infrastructure
- Turnover of faculty with mentor training
- Lack of early career faculty interest in STEM Education Research
- Lack of early career faculty interest in mentoring undergraduates/ graduates
- Disruption of research activities/ mentoring experiences due to natural disasters or COVID- 19
- Mini grant research activity may be adversely affected due to restricted access to K-12 and undergraduate learning spaces because of COVID- 19
- Insufficient time/resources from UVI/R2R faculty to incorporate in WFD activities
- Failed search for Master Teacher
- Emerging demand for virtual technology that exceeds our capacity
- Teacher fatigue and motivation

Appendix B - Acronyms

ADCP ..... Acoustic Doppler Current Profiler
AES ..... Agricultural Experiment Station
AGA ..... American Genetic Association
AISL ..... Advancement of Informal Science Learning
AOML ..... Atlantic Oceanographic and Meteorological Laboratory
AWAC ..... Acoustic Wave and Current (profiler)
CariCoos ..... Caribbean Regional Association for Coastal Ocean Observing System
CEDS ..... Comprehensive Economic Development Strategy
CES ..... Community Engagement Specialist
CFMC ..... Caribbean Fisheries Management Council
CD ..... Communication and Dissemination
CGTC ..... Caribbean Green Technology Center
CMES ..... Center for Marine and Environmental Studies
CR ..... Coral Resilience
CTD ..... Conductivity, Temperature and Depth
CRER ..... Oceanography
DMAC ..... Development of Data Management and Communications
DSS ..... Decision Support System
DPNR ..... Department of Planning and Natural resources
E&O ..... Education and Outreach
EA ..... Emerging Areas
EAB ..... External Advisory Board
EBFM ..... Ecosystem Based Fishery Management
EOD ..... Education, Outreach and Diversity
EFWD ..... Education and Workforce Development
FE ..... Fish ecology
FMP ..... Fisheries Management Plan
H&O ..... Hydrogen and Oxygen
IDP ..... Individualized Development Plan
IL ..... Informal Learning
LTRANS ..... Larval Transport Lagrangian Model
M ..... Mangroves
MD ..... Marine Disease
MMES ..... Masters in Marine and Environmental Science
MR ..... Marine Restoration
NCEI ..... National Centers for Environmental Information
NCRMP ..... National Coral Reef Monitoring Program
NMFS ..... National Marine Fisheries Service
NODC ..... National Oceanographic Data Center
NPS ..... National Park Service
NRT ..... National (Science Foundation) Research Traineeship
OC ..... Oceanography
OM ..... Organic Matter
OCOVI ..... Ocean and Coastal Observing in the VI
QA ..... Quality Assurance
QC ..... Quality Control
PBL ..... Project-Based Learning
PD ..... Professional Development
RL ..... Resilience Leaders
RM ..... Ridge to Reef Management
RMM ..... Risk Management Mitigation

R2R ..... Ridge to Reef
SEFSC..... Southeast Fisheries Science Center
SI..... Stem Institute
SL..... Service Learning
S&T..... Science and Technology
STJ ..... St John
STT ..... St Thomas
STX..... St Croix
SP ..... Sustainability Plan
TCRMP..... Territorial Coral Reef Monitoring Program
TME..... Total Mechanical Energy
UAB ..... University of Alabama, Birmingham
URM ..... Under-Represented Minorities
USCCOM..... US Caribbean Coastal Ocean Model
USVI ..... United States Virgin Islands
UVI ..... University of the Virgin Islands
VIDE..... Virgin Islands Department of Education
VI ..... Virgin Islands
VI-ISERP ..... Virgin Islands Institute for STEM Education Research and Practice
VPS ..... Virtual Positioning Systems
WF..... Workforce
WL ..... Watershed Monitoring and Land Use