



**National Oceanic and
Atmospheric Administration**
U.S. Department of Commerce



**NOAA
CORAL REEF**
CONSERVATION PROGRAM



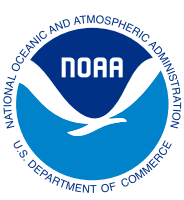
NOAA Strategy for Stony Coral Tissue Loss Disease: An Implementation Plan for Response and Prevention

**United States of America
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Front cover photo: Divers treat corals with antibiotics to stop the spread of stony coral tissue loss disease.
Photo credit: Joe Synder

Contents

4	Executive Summary
5	Addressing unprecedented coral disease
6	NOAA Strategy for Stony Coral Tissue Loss Disease Response and Prevention
7	A clear path forward: Developing an implementation plan
8	Priority objectives from strategy addressed in this implementation plan
9	Building institutional capacity for coral disease research and response within NOAA
11	Securing support to take action
12	Priority activities in the implementation plan
17	Expanded implementation plan activities
17	Goal 1: Expand capacity for research and data collection on SCTLD.
21	Goal 2: Build capacity for coral disease detection, prevention, and intervention.
24	Goal 3: Support coral rescue, propagation, and restoration operations, research and partnerships across the U.S. to preserve the genetic diversity of corals necessary for future restoration efforts and support reef health.
25	Goal 4: Promote awareness of SCTLD science, status, and indicators.
26	Goal 5: Collaborate with the coral reef management community to reduce stressors to coral reefs and build ecosystem resilience.
27	Goal 6: Use the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act and Section 7 Endangered Species Act consultations to ensure SCTLD is evaluated as part of the baseline environmental conditions, in addition to environmental consequences and cumulative impacts that may result from federal actions.
29	Goal 7: Strengthen and expand international partnerships for SCTLD surveillance and sharing of data, best practices, and resources.
30	Goal 8: Work with relevant partners to prevent the spread of SCTLD to the four U.S. coral reef jurisdictions and Freely Associated States in the Indo-Pacific region.
32	References
34	Appendix I: Detailed activities
92	Appendix II: Review team
93	Appendix III: Process timeline
94	Appendix IV: Detailed budget table

Executive Summary

The NOAA Strategy for Stony Coral Tissue Loss Disease (SCTLD): An Implementation Plan for Response and Prevention aims to:

- Build on goals and agency priorities identified in the NOAA Strategy for SCTLD Response and Prevention;
- Outline a detailed, five-year course of action for SCTLD response and prevention;
- Match agency capacity with SCTLD response needs and complement and enhance the efforts of our partners; and,
- Highlight key actions necessary to understand and address this new threat to coral reefs over the long-term.

An Unprecedented Threat

Atlantic-Caribbean coral reef ecosystems are in the midst of an unprecedented outbreak of stony coral tissue loss disease (SCTLD). Characterized by rapid spread, rapid tissue loss, and high mortality rates, SCTLD has affected corals along the entirety of Florida's Coral Reef and in 22 Caribbean countries and territories, including the U.S. Virgin Islands and Puerto Rico. The appearance of a SCTLD-like disease was documented at Flower Garden Banks National Marine Sanctuary in the Gulf of Mexico at the time of this publication. SCTLD is rapidly reducing coral cover in a region already dealing with declining coral reefs. The disease's persistence in affected areas and continued spread represents one of the most important threats currently facing America's coral reefs.

A Strategy for Action

In 2020, NOAA published its Strategy for Stony Coral Tissue Loss Disease Response and Prevention to help guide an agency-wide response to SCTLD. The Strategy provides a framework for NOAA engagement in regional response efforts in affected areas and support for preventative action to limit disease spread. The implementation plan outlines a detailed course of action for SCTLD response and prevention for the next five years. Recognizing that SCTLD will be present on U.S. coral reefs for the foreseeable future, the plan also outlines key actions necessary to address this new threat over the long-term. While it is unlikely that SCTLD will be fully eradicated as a result of this implementation plan, the plan provides major gains in reducing the likelihood of further transmission; preparing vulnerable areas in the event the disease reaches them; saving priority corals in regions whose corals are being heavily impacted; and, contributing to future restoration of highly susceptible species whose populations have been devastated in many areas.

To develop the implementation plan, NOAA assembled a Core Planning Team of agency experts, diverse in both their geographic focus, technical capabilities, and experience. The plan was reviewed by a broader group of NOAA colleagues, external partners, and the U.S. Coral Reef Task Force Coral Disease Working Group. The implementation plan includes areas for both continued effort and new activities that may be carried out by either NOAA or other governmental and nongovernmental partners.

Securing Support

Following the publication of the implementation plan, NOAA and partners will work to identify feasible funding sources to enable the implementation of the activities in this plan. Funding will likely be a mix of existing and new private and public sector funds that will be combined to execute this effort. Once funding is secured, NOAA-led projects will be implemented through NOAA's Coral Reef Conservation Program. Partner-led projects will be supported via grants and external funding. This implementation plan in no way encompasses all of what is needed to fully control and address the impacts of SCTLD; it merely delineates the steps NOAA aspires to undertake in the near-term. While NOAA is currently conducting some of the research and response outlined in this plan, implementing sufficient and lasting interventions will require significant additional investment.

Addressing unprecedented coral disease

From the Florida Keys to the islands of the Indo-Pacific, shallow-water coral reefs are essential to healthy, resilient coastal communities, ecosystems, and economies. Thriving reefs provide critical services, such as fishing; opportunities for tourism and recreation; and powerful shoreline protection from waves, storms, and currents. Coral reefs are valued at \$3.4 billion every year in the U.S. alone.^{1,2} Reefs protect lives, property, and businesses through coastal protection, and provide habitat for 25 percent of all marine species.³ The impacts of coral reefs are therefore far-reaching—both inland and seaward. Currently, coral reefs are

facing a multitude of global and local stressors such as increasing ocean temperatures and acidification, unsustainable fishing, coastal development, extractive and recreational uses, pollution (both land-based and marine), and invasive species. These stressors individually and cumulatively reduce the ability of coral reefs to resist and recover from disturbances, such as mass bleaching, storm events, and outbreaks of disease, which are projected to increase in a warming world.⁴

Atlantic-Caribbean coral reef ecosystems are in the midst of an unprecedented outbreak of a newly described coral disease, Stony Coral Tissue Loss Disease (SCTLD). This particular disease affects at least 22 ecologically important shallow-water reef-building coral species, five of which are listed as threatened species under the Endangered Species Act. This disease is characterized by rapid spread, rapid tissue loss, and high mortality rates of affected colonies. While SCTLD was first reported on Florida's Coral Reef in 2014, reports of its spread to the wider Caribbean region began to occur in early 2018. As of April 2022, SCTLD has affected corals along the entirety of Florida's 360-mile long reef system and has been reported in 23 Caribbean countries and territories, including the U.S. Virgin Islands and Puerto Rico. As of September 2022, the appearance of a SCTLD-like disease was documented at Flower Garden Banks National Marine Sanctuary in the Gulf of Mexico.

There is still much to learn about SCTLD. Since 2016, the National Oceanic and Atmospheric Administration (NOAA), along with our response partner organizations, has been working to:

- document the outbreak,
- identify potential pathogen(s),
- understand how environmental factors may be contributing to the outbreak/spread of the disease,
- develop innovative treatments to slow or halt the spread of the disease,
- support local response efforts in affected jurisdictions,
- facilitate information sharing and capacity building with our international partners, and
- implement best practices to restore damaged habitats.

Affected Species

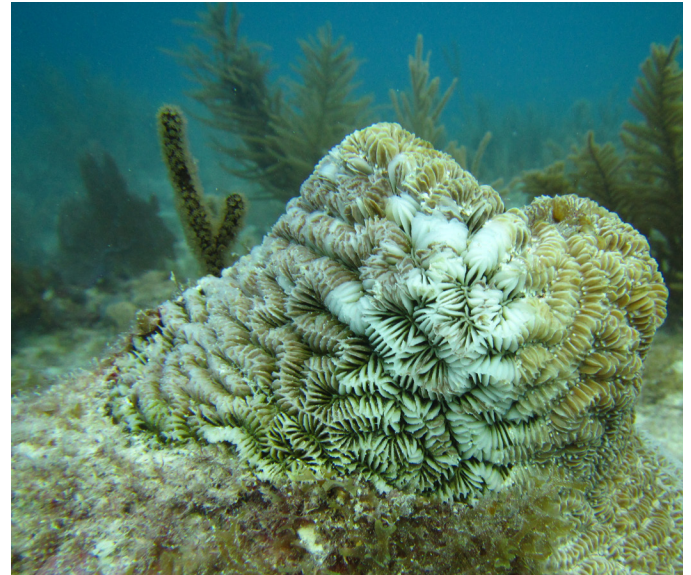
- *Agaricia agaricites* (Lettuce coral)
- *Agaricia fragilis* (Fragile saucer coral)
- *Colpophyllia natans* (Boulder brain coral)
- *Dendrogyra cylindrus* (Pillar coral)*
- *Dichocoenia stokesii* (Elliptical star coral)
- *Diploria labyrinthiformis* (Grooved brain coral)
- *Eusmilia fastigiata* (Smooth flower coral)
- *Meandrina meandrites* (Maze coral)
- *Montastraea cavernosa* (Great star coral)
- *Madracis auretenra* (Ten-ray star coral)
- *Mycetophyllia* spp. (Cactus coral)*
- *Orbicella annularis* (Lobed star coral)*
- *Orbicella faveolata* (Mountainous star coral)*
- *Orbicella franksi* (Boulder star coral)*
- *Porites astreoides* (Mustard hill coral)
- *Porites porites* (Clubtip Finger Coral)
- *Pseudodiploria strigosa* (Symmetrical brain coral)
- *Pseudodiploria clivosa* (Knobby brain coral)
- *Siderastrea radians* (Lesser starlet coral)
- *Siderastrea siderea* (Massive starlet coral)
- *Solenastrea bournoni* (Smooth star coral)
- *Stephanocoenia intersepta* (Blushing star coral)

* Listed under the U.S. Endangered Species Act

State and Territorial governments are supporting local response efforts in each of the three affected U.S. coral reef jurisdictions (Florida, the U.S. Virgin Islands, and Puerto Rico). NOAA is supporting both regional and national level coordination to facilitate communication, identify information and resource gaps, and efficiently allocate federal resources to support an effective response to this current threat to U.S. coral reef resources. While scientists have determined that SCTLD can be transmitted via direct contact and seawater, they are still working to determine how it is traveling across the broader Caribbean region as its appearance has not followed known oceanographic circulation patterns. NOAA is actively working with federal partners to research potential vectors/sources for SCTLD transmission related to shipping activity, such as the release of ballast water.

As the SCTLD outbreak unfolds in the Caribbean and potentially the Gulf of Mexico, questions regarding how it is transmitted and concerns regarding its potential spread to the Indo-Pacific region are rising. U.S. coral reef jurisdictions in the Indo-Pacific region include the State of Hawai'i, the Territories of Guam and American Samoa, and the Commonwealth of the Northern Mariana Islands, as well as islands and atolls in the central Pacific collectively referred to as the Pacific Remote Island Area, which includes Johnston and Palmyra Atolls, Kingman Reef, and Wake, Jarvis, Baker, and Howland Islands. NOAA also works closely on coral reef conservation efforts with our partners in the Freely Associated States of the Republic of Palau, Federated States of Micronesia, and Marshall Islands. Indo-Pacific reefs are represented by an even greater diversity of stony coral species, including many of the same coral families and genera that are found in the Atlantic-Caribbean region; therefore, the threat potential to the Indo-Pacific is of grave concern.

In the Atlantic-Caribbean region, SCTLD is now well established, and coordinated research and response efforts are underway. Through NOAA, the Florida Department of Environmental Protection (Florida DEP), the U.S. Environmental Protection Agency (EPA), and other funding sources, important progress has been made to characterize the histopathological



Nearly half of the known stony coral species in Florida and at least one third of species documented throughout the Caribbean are susceptible to SCTLD. Photo credit: Ben Edmonds/NOAA.

characteristics of SCTLD-affected tissues,⁵⁻⁷ and coral microbiomes in several stony coral species.⁸⁻¹⁰ Most recently, investigations are underway that seek to better understand the underlying environmental, biochemical, physiological, and genetic mechanisms governing susceptible and resistant individuals to SCTLD, along with the role algal symbionts may play in disease dynamics. However, fundamental research questions remain regarding the interplay of disease agents, susceptible hosts, and the environment; and how changes in these responses modulate the development and progress of SCTLD. Answers to these questions are needed to develop effective surveillance, prevention, control, and intervention strategies as indicated by the National Academies of Sciences, Engineering, and Medicine review of the quickly evolving science of novel ecological and genetic coral intervention strategies and the subsequent NOAA Action Plan on Coral Interventions.¹¹

NOAA Strategy for Stony Coral Tissue Loss Disease Response and Prevention

Recognizing that bold action is required to maintain U.S. coral reef ecosystems, preserve genetic diversity

for future restoration, and prevent further spread of SCTLD, NOAA published its [Strategy for Stony Coral Tissue Loss Disease Response and Prevention in November 2020](#).¹² The strategy identifies a series of goals and objectives designed to:

- Expand NOAA's capacity to respond to the disease outbreak in the Atlantic-Caribbean region;
- Support timely, efficient, and effective action to slow the outbreak by unifying regional efforts under a NOAA response framework that is national in scope; and
- Prevent and prepare for the potential spread of SCTLD to the Indo-Pacific region.

In doing so, the strategy prioritizes clearly defined research questions, aims, objectives, and coordination among research teams, response teams, and partners. It also recognizes the importance of promoting innovation through new partnerships. This will aid in the integration of emerging technologies to expand capacity for data collection, management, and analysis of this disease, helping to meet the goals and objectives set out in the strategy. Technological integration of SCTLD response efforts will also be critical to implementing and scaling restoration approaches, improving ecosystem assessments and predictions, and monitoring reef health in response to environmental change.

A clear path forward: Developing an implementation plan

The implementation plan for NOAA's Stony Coral Tissue Loss Disease (SCTLD) Response and Prevention Strategy outlines a detailed course of action for SCTLD response and prevention and integrates new technologies. By matching agency capacity with SCTLD response needs, and complementing efforts of our partners, the implementation plan expands on Strategy goals and agency priorities.

The implementation plan prioritizes objectives from the strategy document that, over the next five years, will be most impactful in disease response and prevention efforts. Recognizing that SCTLD will likely be present on U.S. coral reefs for the foreseeable future, the implementation plan also highlights key actions

Goals established in the strategy

1. Expand capacity for research and data collection on SCTLD
2. Build capacity for coral disease detection, prevention and intervention
3. Support coral rescue, propagation and restoration operations, research and partnerships across the U.S. to preserve the genetic diversity of corals necessary for future restoration efforts and support reef health
4. Promote awareness of SCTLD science, status, and indicators
5. Collaborate with the coral reef management community to reduce stressors to coral reefs and build ecosystem resilience
6. Use the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act and Section 7 Endangered Species Act consultations to ensure SCTLD is evaluated as part of the baseline environmental conditions, in addition to environmental consequences and cumulative impacts that may result from federal actions
7. Strengthen and expand international partnerships for SCTLD surveillance and sharing of data, best practices, and resources
8. Work with relevant partners to prevent the spread of SCTLD to the four U.S. coral reef jurisdictions and Freely Associated States in the Indo-Pacific region

necessary to understand and address this new threat to coral reefs over the long-term. Highlighting priority areas for both continued effort and new activities that require increased investment, the implementation plan focuses on actions that fall within NOAA's capabilities and those that may be carried out by either NOAA or other governmental and nongovernmental partners.

Priority objectives from strategy addressed in this implementation plan

Goal	Objective
1	Objective 1b: Identify data gaps and sampling needs.
	Objective 1c: Explore alternative treatment options, such as probiotics and other colony- and reef-level treatments.
	Objective 1e: Promote multi-sector projects and partnerships to study potential vectors/sources, such as ballast water, biofilms, and other sea systems with regard to transmission over small and great distances.
	Objective 1g: Expand applications of 'omics, artificial intelligence (AI), and uncrewed systems for surveillance (e.g., water quality, coral health across reef zones, including mesophotic reefs) and/or research (e.g., understanding coral resilience, SCTLD etiology/pathology).
	Objective: 1h: Conduct laboratory transmission experiments with Pacific corals to identify susceptibility of Pacific coral species to SCTLD and incorporate results into SCTLD surveillance and preparedness planning.
2	Objective 2a: Coordinate exchange of information, personnel, and best practices between Atlantic and Indo-Pacific MPAs and other local jurisdictions.
	Objective 2b: Support workshops and training sessions to increase capacity for communication, detection of and monitoring for SCTLD.
	Objective 2c: Support the development and/or updating of jurisdiction-specific response plans.
	Objective 2e: Institute surveillance protocols to provide early warning and track disease progression.
	Objective 2f: Scale NOAA capacity to respond to and treat affected coral in U.S. coral jurisdictions.
	Objective 2g: Support citizen science-based reporting systems to increase spatial awareness of SCTLD.
3	Objective 3e: Establish a U.S. Caribbean coral rescue effort.
4	Objective 4a: Partner with regional networks, initiatives, reef managers, and community leaders to develop and distribute resources to increase awareness and understanding of SCTLD.
	Objective 4b: Work with other federal agencies on the U.S. Coral Reef Task Force to ensure SCTLD awareness and to facilitate its consideration in federal decision-making.
5	Objective 5c: Improve coral reef habitat quality and restore ecosystem function.
6	Objective 6b: Ensure that mitigation activities that result from consultations reflect SCTLD intervention and restoration best practices.
7	Objective 7a: Prepare unaffected international jurisdictions for surveillance and intervention response.
	Objective 7b: Increase international capacity for and coordination of surveillance, data collection, rescue, communications, and response planning.
8	Objective: 8a: Continue to promote best management practices for ballast water treatment with the maritime industry domestically and internationally, and continue support for research on the connection between ballast water treatment and other sea systems.
	Objective 8b: Work with the EPA, U.S. Coast Guard and jurisdictional environmental enforcement authorities to promote active enforcement of existing regulations as they pertain to ballast water discharge under current regulations and future regulations under the Vessel Incidental Discharge Act (VIDA).

To develop the implementation plan, NOAA assembled a Core Planning Team of agency experts, diverse in both their geographic focus and technical capabilities and experience. The Core Planning Team prioritized objectives from the Strategy to be implemented from 2022–2027 based on urgency, level of impact, and feasibility (listed on the previous page). Urgency and level of impact were the most important criteria; the feasibility of a given objective was considered, but objectives were not excluded simply because they were more difficult to accomplish. Because the Team decided to prioritize objectives, not all objectives from the Strategy are included in the implementation plan.

Once priority objectives were identified, the Core Planning Team identified a series of key activities for each objective to be implemented over a five-year timeframe that would lead to significant progress on each objective. Then, a plan was developed for each activity to articulate a clear, specific way forward with measurable outcomes. The Core Planning Team conducted an internal review of activity plans before sending a draft for review by a broader group of NOAA colleagues, external partners, and the U.S. Coral Reef Task Force Coral Disease Working Group (Appendix II). The Working Group consists of nearly 50 members representing the NOAA, National Park Service, Environmental Protection Agency, Coast Guard, Smithsonian Institute, National Science Foundation, U.S. Geological Survey, and all seven state and territorial governments from U.S. coral jurisdictions. The Core Planning Team then revised activities based on comments from the broader review team and a final document was provided to NOAA Office for Coastal Management leadership for final review (See Appendix III for process timeline).

Building institutional capacity for coral disease research and response within NOAA

Establish NOAA Center of Excellence for Marine Disease Investigations:

Climate change and human disturbances in marine environments are expected to increase the frequency and severity of disease outbreaks. The ability to quickly respond to



A scuba diver swims over a coral reef in Florida. Surveys of coral ecosystems are important for finding and diagnosing SCTLD. Photo credit: Kip Evans.

such disease events, both in the context of SCTLD as well as other marine diseases, is contingent on adequate infrastructure and specialized personnel at appropriate levels. Specifically, a dedicated facility with a director with disease expertise, along with staff trained in laboratory diagnostics (e.g., histopathology, culturomics, diagnostic screening, epidemiology) and field staff to lead systematic field investigations (i.e., field investigators) and response teams using incident command protocols are needed.

The Center infrastructure should have appropriate biocontainment and biosecurity features to support Biolevel I, II and III level work and prevent release of pathogens into the environment. The facility should contain a seawater system for natural and artificial seawater, areas of natural lighting, and controlled

aquatic life-support systems (i.e., controllers for light cycling, temperature, salinity, and other water quality parameters). Education, outreach, and tech-transfer are also integral to The Center's mission by providing assistance in training, development of protocols, and support for field activities. The estimated total cost to develop and implement the Center of Excellence over the five-year period of this plan is \$11,104,000, most of which represents additional funding NOAA would need above Fiscal Year 2022 enacted funding levels in order to properly establish the Center of Excellence.

Increase Capacity for Coral Disease Data

Management: Collecting, organizing, and archiving metadata, data, and images with the ability to provide searchable content through a data portal are critical functions of The Center. The data portal is needed for analysis and synthesis of available data as well as data gaps to provide a clearer picture of the disease outbreak. Increasing the pace from step 1 (data becomes available) through step 2 (hypotheses are developed) and 3 (epidemiological analyses and refinement) is a priority. These efforts will allow us to be better prepared to mitigate disease outbreaks and inform management strategies to enhance conservation and restoration initiatives. NOAA remains the most qualified organization to develop a Center of Excellence, which will support the ability of the federal government to remain at the forefront of disease response efforts. A Center of Excellence also aligns with [NOAA's 'Omics Strategic Plan Goals 1 and 5](#) to enhance infrastructure and promote workforce proficiency.

Prioritize SCTL D Research, Detection, Prevention, and Response in NOAA Grant Programs: NOAA's Coral Reef Conservation Program (CRCP) and the National Fish and Wildlife Foundation (NFWF) have multiple funding opportunities to support coral reef conservation and the reduction of threats to coral reef ecosystems. Both programs work with key jurisdictional partners (including NOAA coral reef management and fisheries liaisons, other locally based

NOAA personnel in coral jurisdictions, and State and Territorial coral reef managers) to identify funding priorities for these grant opportunities. NOAA CRCP and NFWF have also recently initiated a new funding opportunity to support the efficient and timely response to coral reef emergency events. These funds have already been used to support SCTL D intervention efforts in the Dry Tortugas region of Florida's Coral Reef and coral rescue efforts in the U.S. Virgin Islands.

NOAA CRCP is committed to working with its grants team to implement grant opportunities that prioritize SCTL D research, detection, prevention, and response. Notices regarding relevant funding opportunities will be circulated among jurisdictional partners with a focus on connecting applicants with relevant projects.



Increasing coral disease research and response are part of NOAA's SCTL D Strategy and Implementation Plan. Photo credit: FWC.



Securing support to take action

Following the publication of the implementation plan, NOAA and partners will work to identify feasible funding sources to enable the implementation of the activities in this plan. Full funding is required for the effective, expeditious implementation of the activities. However, it is not expected to come from a single source. Instead, it will likely be a mix of existing and new private and public sector funds that will be combined to execute this effort. Once funding is secured, NOAA-led projects will be implemented through NOAA's Coral Reef Conservation Program. Partner-led projects will be supported via grants and external funding. It is anticipated that the majority of funds called for to support this plan will be allocated to external partners via grants. This implementation plan in no way encompasses all of what is needed to fully control and address the impacts of SCTLD; it merely delineates the steps NOAA aspires to undertake in the near term. While NOAA is currently conducting some, but not all of the research and response outlined below, implementing sufficient and lasting interventions will require significant additional investment.

Implementation plan priority activities (outlined in a subsequent section) will be funded and implemented first. An annual report will be produced to highlight progress on the implementation of the plan and any major modifications to the priorities of the plan based on changing circumstances. See expanded activities section (page 17) for budgets by activity and Appendix IV for a detailed budget table.

Goal	Required budget for implementation
1 Expand capacity for research and data collection on SCTLD (includes \$65,000,000 for new grant competitions to support partner engagement and innovation in SCTLD research)	\$68,750,000
2 Build capacity for coral disease detection, prevention, and intervention	\$6,841,000
3 Support coral rescue, propagation, and restoration operations and research and partnerships across the U.S. to preserve the genetic diversity of corals necessary for future restoration efforts and support reef health	\$36,750,000
4 Promote awareness of SCTLD science, status, and indicators	\$485,000
5 Collaborate with the coral reef management community to reduce stressors to coral reefs and build ecosystem resilience	\$0
6 Use the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act and Section 7 Endangered Species Act consultations to ensure SCTLD is evaluated as part of the baseline environmental conditions, in addition to environmental consequences and cumulative impacts that may result from federal actions	\$90,000
7 Strengthen and expand international partnerships for SCTLD surveillance and sharing of data, best practices, and resources	\$955,000
8 Work with relevant partners to prevent the spread of SCTLD to the four U.S. coralreef jurisdictions and Freely Associated States in the Indo-Pacific region	\$25,000
NOAA Center of Excellence for Marine Disease Investigations	\$11,104,000
TOTAL	\$125,000,000

Priority activities in the implementation plan

The Core Planning Team identified priority activities for each goal that are most critical for combating the threats posed by SCTLD. Priorities were identified based on the level of impact, urgency, and feasibility of each activity. The number of priorities per goal was determined based on the number of objectives and activities included in each goal. It is essential to implement these activities as soon as possible to effectively respond to SCTLD and prevent further spread of the disease. Below is a list of priority activities, including a brief explanation of their significance.

Goal 1: Expand capacity for research and data collection on SCTLD

Research Audit and Synthesis

The research audit will collect, organize, and archive metadata, data, and images into a searchable portal, ensuring all project related data are available in one accessible location. This will ultimately support effective analysis and synthesis of what is known about SCTLD and where data gaps exist. Synthesis of these data is critical to understanding complex interactions and making well-informed decisions in the midst of the disease outbreak.

SCTLD Transmission Experiments

Identifying routes and vehicles that move disease through populations is a key step to designing intervention and prevention strategies by managing critical control points in the transmission process. Particular emphasis should be placed on abiotic and human-mediated sources of disease transport, such as ships' ballast water systems and hull biofilms, sediments, and dive gear. Then evaluations of treatment and mitigation strategies including ballast water treatment and disinfection can occur. Research that examines the potential longevity of SCTLD pathogens in such disease sources is also of critical importance.

Identification of Causation and Diagnostic Development

A central priority of the implementation plan is to determine the causation of Stony Coral Tissue Loss Disease. Determining causation of SCTLD is important because it allows policies and programs to better target and manage disease outbreaks for quicker resolution and improved future prevention efforts. Often a disease outcome is due to multiple factors, which are composed of causal factors and correlative associations. Identifying causal factors and their role in disease development provide the opportunity to manage or control those factors. This knowledge fuels the development of diagnostic tests, effective treatments, and preventative measures. Diagnostics, treatments, and preventative measures will contribute to stopping the spread of the disease.

Evaluating the Susceptibility of Pacific Corals

SCTLD may be transferable to Indo-Pacific corals, but more research is needed to determine which coral and zooxanthellae species in the region may be susceptible. This information is essential to evaluate the risks to Pacific reefs and improve preparedness through more targeted prevention and response plans. Current preparedness efforts have identified this as a significant gap.

Goal 2: Build capacity for coral disease detection, prevention, and intervention

SCTLD Preparedness in the U.S. Indo-Pacific

Supporting the development and distribution of resources and tools for SCTLD preparedness planning in the U.S. Indo-Pacific will provide needed information and technical expertise to Pacific coral managers and practitioners, allowing them to prepare strategic responses to coral disease outbreaks.

Pacific Preparedness Workshops and Trainings

The implementation of a series of workshops and trainings in unaffected Pacific jurisdictions would greatly increase capacity for prevention, preparation, and response and facilitate the transfer of information and lessons learned from the Atlantic/Caribbean region.

Preparedness and Surveillance Planning – Unaffected Jurisdictions

The development of SCTLD response and preparedness plans and surveillance protocols in unaffected jurisdictions is critical to their ability to respond to a coral disease outbreak rapidly and effectively, helping to preserve coral and health and biodiversity in the U.S. Indo-Pacific region.

Monitoring and Surveillance for SCTLD in Affected and Unaffected Jurisdictions

Increasing funding and investment in jurisdictional monitoring and surveillance programs in both affected and unaffected areas is essential to disease detection and subsequent response and treatment. This activity will ensure local programs have the capacity they need to effectively respond to the disease. It will also ensure that SCTLD surveillance is integrated into the National Coral Reef Monitoring Program where appropriate.

Treatment and Intervention in Affected Jurisdictions

Increasing NOAA's investment in treatment and intervention in affected jurisdictions is critical to keeping corals alive in the wild and protecting high value coral colonies from the high levels of mortality caused by SCTLD.

National Coral Disease Coordination Capacity

Maintaining and enhancing national coral disease coordination capacity is essential to the effective implementation of this plan and NOAA's ability to coordinate, track, and report out on progress on its disease response and prevention efforts.

Goal 3: Support coral rescue, propagation, and restoration operations and research and partnerships across the U.S. to preserve the genetic diversity of corals necessary for future restoration efforts and support reef health

Coral Rescue Coordinator

Hiring a coral rescue coordinator to lead efforts to plan and execute coral rescue activities in the U.S. Virgin Islands and Puerto Rico is critical to the success of regional coral rescue efforts. The coordinator will advance plans for rescue, coordinate the work of partners and experts, and identify resources to support rescue and restoration efforts. Rescue efforts will be greatly improved and impactful with a coral rescue coordinator in place.

Establishment of Land-Based Coral Nurseries

Hiring a coral rescue coordinator to lead efforts to plan and execute coral rescue activities in the U.S. Virgin Islands and Puerto Rico is critical to success. The coordinator will advance plans for rescue, coordinate the work of partners and experts, and identify resources to support rescue and restoration efforts. Rescue efforts will be greatly improved and more impactful with a coral rescue coordinator in place.

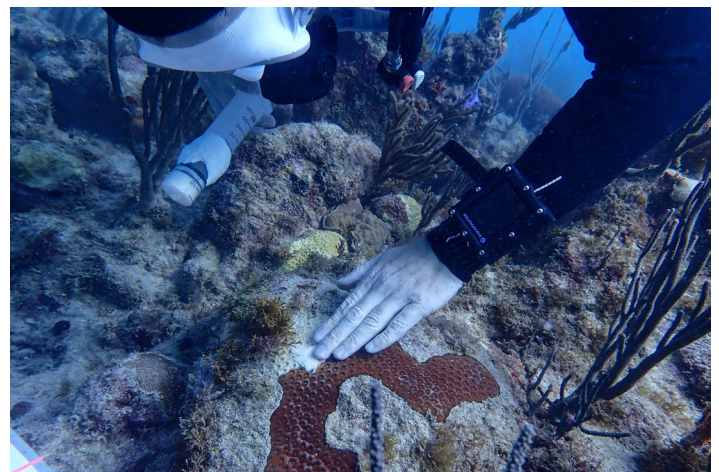
Goal 4: Promote awareness of SCTLD science, status, and indicators

National SCTLD Communications Strategy

The development and implementation of a national-level SCTLD communications strategy will ensure consistent messaging about the threat posed by SCTLD and the tremendous value of research and response efforts, increasing awareness about the disease, building partnerships, and strengthening support for continued action to protect coral reefs.

U.S. Coral Reef Task Force Coral Disease Working Group

The U.S. Coral Reef Task Force Coral Disease Working Group ensures coordination and communication among a broad group of federal and jurisdictional agencies that play a role in coral disease research, response, prevention, and preparedness. The group provides a framework for interagency action and capacity building that is needed for effective disease response efforts.



*Coral interventions (left) and rescue (right) are both important for improved coral health and restoration.
Photo credits: Blake Gardner (left) and Sonora Meiling/UVI.*

Goal 5: Collaborate with the coral reef management community to reduce stressors to coral reefs and build ecosystem resilience

Integrating Coral Disease into Restoration Plans

Given the severe decline in the coverage of stony corals in the Atlantic/Caribbean region due to SCTLD and the threat it poses to corals in the Indo-Pacific, restoration efforts must account for the impacts of the disease and integrate species affected by SCTLD into restoration plans.

Goal 6: Use the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act and Section 7 Endangered Species Act consultations to ensure SCTLD is evaluated as part of the baseline environmental conditions, in addition to environmental consequences and cumulative impacts that may result from federal actions

Standard Operating Procedures for SCTLD Monitoring Before and During Coastal Development Activities

Science suggests that sediment can act as a reservoir for SCTLD. Thus, in the wake of large-scale port dredging projects planned in southeast Florida in the near future and future dredging projects elsewhere, it is essential to reduce the potential for SCTLD infection from these projects. This activity will help determine the prevalence of disease in a project area and implement adaptive management actions to minimize the chances of spread.

Goal 7: Strengthen and expand international partnerships for SCTLD surveillance and sharing of data, best practices, and resources

SCTLD Training and Technical Assistance for the International Caribbean

SCTLD has spread rapidly throughout the Caribbean region, with many Caribbean countries struggling to manage the disease's severe impacts on their reefs. Given the connectivity of coral reef ecosystems throughout the Wider Caribbean region, targeted training and technical assistance will enhance the ability of the international Caribbean to respond to the disease and protect and enhance the integrity of reefs throughout the region.



Standard Operating Procedures, training, and technical assistance will help Caribbean countries struggling to manage SCTLD's impacts. Photo credit: Virgin Islands Coral Disease Advisory Committee.

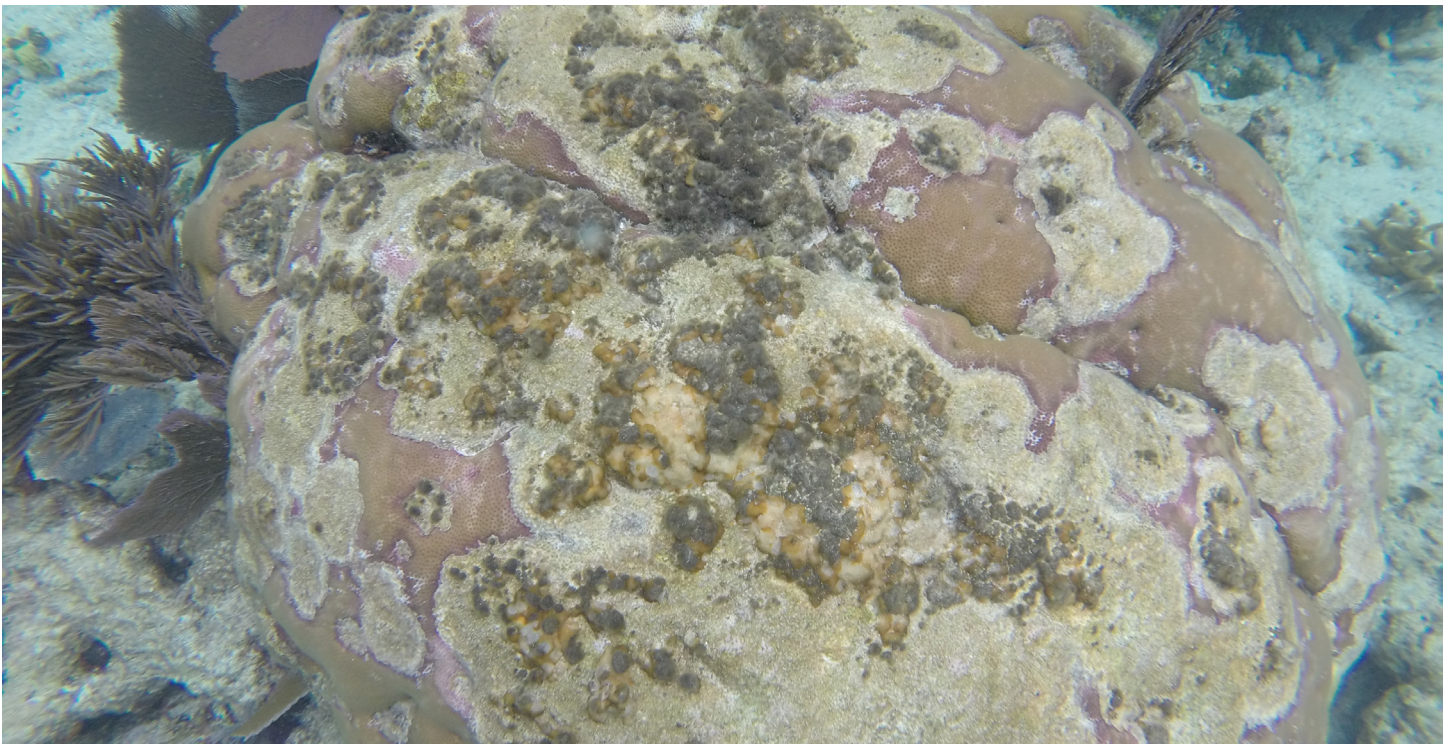
Goal 8: Work with relevant partners to prevent the spread of SCTLD to the four U.S. coral reef jurisdictions and Freely Associated States in the Indo-Pacific region

Ballast Water Best Management Practices

Research has indicated that ballast water can indeed act as a transmission source for SCTLD.¹² In order to prevent further spread of the disease, particularly from the Atlantic to the Pacific, it is critical to update and promote ballast water best management practices with the maritime industry. Therefore, additional research is needed to determine the risk associated with ballast water transport of SCTLD, the persistence of SCTLD pathogens in ballast water systems, and the success of ballast water treatment methods in mitigating the risk of disease transmission.

Building Partnerships for Ballast Water Management

U.S. federal and state agencies need to build closer partnerships with regional and international organizations to disseminate information about SCTLD transmission and strategies. Outreach to, and coordination with, international organizations (e.g., International Maritime Organization) is essential to halting the spread of the disease, both regionally and globally. The IMO currently has 175 Member States (including the United States) and three Associate Members. U.S. flagged vessels represent a relatively small percentage of the gross tonnage of the global merchant fleet. As of July 15, 2021, 86 countries (representing 91.12% of the gross tonnage of the global merchant fleet) were contracting States to the IMO ballast water management Convention. However, the United States is not party to this convention. As such, it will be important to work closely with international shipping organizations to communicate the impact of SCTLD and work to define mitigation strategies.



Stony coral tissue loss disease infected and subsequently killed this coral in Florida. Photo credit: Llsa Morse.

Expanded implementation plan activities

Goal 1: Expand capacity for research and data collection on SCTLD. (\$68,750,000)

Scientists have made remarkable progress in characterizing the defining features of SCTLD, its impacts, and how it is transmitted. Unfortunately, the causative agent(s) remain unknown and there is currently no diagnostic test for the disease. The fact that antibiotic treatments can stop or slow disease progression on sick corals suggests a potential bacterial role in the disease.⁹ However, a new line of investigation is examining the role viruses may play in SCTLD pathology. NOAA is funding and participating in collaborations to determine the cause and drivers of this disease, biomarkers of susceptibility, and resistance among corals. The Coral Disease and Health Consortium (CDHC), which was created in 2002 in response to the U.S. Coral Reef Task Force's National Action Plan to Conserve Coral Reefs, is a network of field and laboratory scientists, coral reef managers, and agency representatives devoted to understanding coral health and disease. The CDHC has been instrumental in leading research efforts to better understand SCTLD.

Through highly collaborative research projects, scientists are seeking to gain insights into species susceptibility and disease dynamics. For example, algal biologists have discovered that corals with certain algal symbionts are more susceptible to the disease than others, while other researchers have identified various environmental risk factors that appear to influence disease dynamics. In terms of disease treatment, the application of an antibiotic paste to affected coral has shown the most success. Though effective, this method treats one colony at a time; thus, it is time- and resource-intensive. Alternative treatments are under investigation and in trial use, including the use of probiotic treatments that could potentially treat affected corals in the wild and inoculate restoration corals that will be planted back onto reefs. Scientists are also seeking to expand their understanding of disease transmission, confirming that SCTLD can be transmitted through direct contact with sick corals and indirectly through methods like ocean currents and sediment.^{9,14-18}

Research indicates that disease-associated microbes may reside in sediments¹⁹ and that ballast water—water stored in a ship's hull to provide stability—may be transmitting the disease pathogens when ballast water or sediment potentially exposed to SCTLD is discharged near coral reef ecosystems.¹³

Goal 1 activities build on the research conducted to date by supporting critical, outstanding research that will close the gaps in knowledge and greatly improve our ability to inform an effective response to the disease and mitigate the threat of continued transmission.

Identify data gaps and sampling needs.

Activity 1: Research Audit and Synthesis (\$1,075,000, priority)

Conduct a research audit that collates information on completed, ongoing, and new projects related to SCTLD within Florida and the Caribbean. The main product will be a populated data portal with search



Application of antibiotic paste to affected corals has shown to be successful in stopping or slowing the progression of SCTLD lesions. Photo credit: Joe Synder.

and data archiving capabilities for existing and future data and metadata of SCTLD research studies and intervention efforts. It will include fields such as species evaluated and locations, hypotheses tested or generated, and general conclusions.

Activity 2: Standard Operating Procedures for Sample/Data Collection/Intervention (\$1,100,000)

Develop standard operating procedures (SOPs) that support landscape epidemiology and include: 1) data collection and monitoring related to disease, environmental, and ecological data that are needed for calculating epidemiological parameters (e.g., prevalence, incidence, incidence rate, mortality rate, case fatality, survival) and necessary for regional comparisons, 2) sample collection related to coral biopsies and reservoirs of disease (e.g., water, sediment), and 3) disease intervention approaches (e.g., antibiotic application, probiotic treatment) that include assessment measurements appropriate for determining effectiveness. The development and application of these SOPs will support epidemiological investigations, allow for regional comparisons of disease dynamics (e.g., patterns of disease occurrence), and assist in understanding disease and environmental risk factors involved in driving the spread, transmission, and maintenance of disease in populations.

Explore alternative treatment options, such as probiotics and other colony- and reef-level treatments.

Activity 1: Direct & Ecological Interventions (\$15,000,000)

Issue a biennial open request for proposals (RFPs) to support research projects focused on identifying alternative options for either direct treatments or indirect interventions for SCTLD. Research projects should explore alternatives to lesion-level treatments including colony-level and reef-level treatment (e.g., probiotic application, antiviral application), methods of enhancing the success of current intervention techniques, and potential ecological interventions like the removal of coral predators, manipulation of coral cover, etc. Due to environmental compliance requirements and because interventions affect the environment, an evaluation of the indirect and cumulative impacts for the intervention would be required as part of the proposed experimental design, in efficacy and effectiveness determinations, and in any permitting/reporting requirements.

Promote multi-sector projects and partnerships to study potential vectors/sources, such as ballast water, biofilms, and other sea systems with regard to transmission over small and great distances.

Activity 1: SCTLD Transmission Experiments (\$275,000, priority)

Support research to inform SCTLD impact avoidance strategies from ship-based (e.g., ballast water, biofilms) and other disease sources (e.g., dive equipment), as well as treatment approaches (e.g., approved Ballast Water Treatment Systems [BWTS], anti-fouling, dive gear disinfection) to assess longevity of SCTLD infection and transmission reduction and prevention strategies.

Activity 2: Risk Profile for Vessels (\$0)

Create a risk profile for vessels traveling from Florida/the Caribbean to the Pacific as a targeted approach to inform compliance and in-water monitoring. Vessels identified as higher risk could require compliance inspection to ensure they are meeting current ballast water discharge regulations.

Activity 3: Identification of High-Risk Ports in the Pacific (\$0)

Use a risk assessment for unaffected areas and ports as a predictive approach and to guide local in-water Pacific coral reef surveillance and monitoring efforts in high-risk ports.

Activity 4: Research for Coastal Construction SCTLD Impact Avoidance Strategies and Integration of Findings into Mitigation Efforts (\$200,000)

Support research to inform SCTLD impact avoidance strategies from coastal construction activities such as dredging, including these four priorities: (1) investigate how long sediments can remain infectious with SCTLD, (2) research the role sediments serve as a disease reservoir versus a means of pathogen transport, (3) evaluate mitigation and transmission reduction methodologies using sediment sources as a model, and (4) understand the susceptibility of coral species, including those listed under the Endangered Species Act, to SCTLD infection from sediment movement.

Expand applications of 'omics, artificial intelligence (AI), and uncrewed systems for surveillance (e.g., water quality, coral health across reef zones, including mesophotic reefs) and/or research (e.g., understanding coral resilience, SCTLD etiology/pathology).

Activity 1: Use Artificial Intelligence (AI) for SCTLD Detection (\$1,000,000)

Advancing technologies in uncrewed platforms and image recognition algorithms have increased our ability to autonomously explore and characterize benthic habitats through photo quadrats and photogrammetry of large plots. Post-processing identification of coral taxonomy to the species level is also available. Most of these technologies are optimized for deeper environments, including mesophotic coral ecosystems found between 30-150m due to logistical challenges of deploying remotely operated vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs) at shallower depths. Continued development of these technologies should be directed toward increasing the ability to identify signs of stress on coral communities, including SCTLD. Specifically, research activities should give priority to improving artificial intelligence and/or cloud computing technologies in analysis and detection of disease from existing and new photo and video datasets.

Activity 2: Evaluation of Coral Resilience and Resistance to SCTLD (\$30,000,000)

Issue competitive request for proposals to support research projects focused on identifying resilience and resistance among coral genotypes, coral populations, and specific reef locations, and the identification of biomarkers that can help screen for these traits. Research may also focus on the assessment of environmental indicators of reef health and the identification of ways to improve restoration success in the face of disease outbreaks. These research efforts should incorporate an examination of coral genotypes, algal symbionts, and microbial communities. Results will not only benefit efforts related to SCTLD but will enhance the ability to identify resilient coral genotypes across multiple stressors.

Activity 3: Identification of Causation and Diagnostic Development (\$20,000,000, priority)

Issue competitive request for proposals (RFP) to fund research to support (1) the investigation of SCTLD causation and risk factors that affect disease dynamics and (2) the development of diagnostics for determining SCTLD susceptibility and/or resistance of coral colonies and confirmatory tests of clinical and/or sub-clinical conditions specific for SCTLD. The use of transdisciplinary, multi-investigator studies of disease provides an integrated approach that more readily extends the understanding of disease dynamics. Priorities under this RFP will include projects with multi-investigator teams using common samples and integrated transdisciplinary approaches (e.g., histopathology, epidemiology, genomics, transcriptomics, proteomics, metabolomics, and culturomics) for differential diagnostics (e.g., identification of morphological and pathophysiological shifts among healthy and diseased individuals).

Conduct laboratory transmission experiments with Pacific corals to identify susceptibility of Pacific coral species to SCTLD and incorporate results into SCTLD surveillance and preparedness planning.

Activity 1: Evaluating the Susceptibility of Pacific Corals (\$100,000, priority)

Determine if Pacific species are susceptible through ex situ experimentation, with an initial focus on *Pocillopora* and *Porites*, the primary reef-building genera in the eastern tropical Pacific. Share results and findings with local jurisdictional resource managers.

Activity 2: SCTLD Surveillance in Panama (\$0)

Coordinate with the Smithsonian Tropical Research Institute in Panama to incorporate SCTLD surveillance into monitoring protocols in Panama's Pacific and Caribbean regions. The detection of SCTLD in Panama would indicate that the disease is spreading into the Pacific.



Laboratory experiments and ex-situ nurseries are helping in the fight against stony coral tissue loss disease. Photo credit: Bethany Bagler.

Goal 2: Build capacity for coral disease detection, prevention, and intervention. (\$6,841,000)

On-the-ground SCTLD response efforts in Florida, the U.S. Virgin Islands, Puerto Rico, and Flower Garden Banks National Marine Sanctuary are managed by state, territorial, and federal coral reef managers, who have done an incredible job developing and implementing innovative and effective management initiatives with limited resources. In response to the disease threat, a massive collaboration has emerged among scientists, resource managers, and others at universities, nonprofits, and aquariums around the world. Florida is a global leader in SCTLD response and rescue efforts, pioneering treatment and surveillance strategies that have been used by other jurisdictions. The U.S. Virgin Islands developed the Virgin Islands Coral Disease Advisory Committee, developing and implementing a formal response plan maximizing the number of corals treated on affected reefs. In Puerto Rico, the Governor formally declared SCTLD to be an ecological emergency, directing resources to support critical response efforts state-wide. After detecting the appearance of an SCTLD-like disease, Flower Garden Banks National Marine Sanctuary and key partners quickly responded and coordinated a reconnaissance and intervention mission days later. This was possible due to proactive preparedness efforts and the development of [a response plan in 2021](#). Despite the significant progress that has already been made, continued support for these efforts is needed as SCTLD transitions from an emergency situation to an endemic disease that will have continued impacts on the composition and health of coral reefs for decades to come.

If SCTLD is indeed spread via the movement of vessels, it is possible for the disease to spread from the Caribbean through the Panama Canal and into the Pacific Ocean. SCTLD has not yet been detected on Indo-Pacific coral reefs and the likelihood of the spread of the disease into the Pacific basin is unknown. However, given the scale of devastation caused by the disease in the Atlantic/Caribbean region, it makes sense for the Pacific coral reef conservation community to be prepared. The U.S. Coral Reef Task Force Coral Disease Working Group created a Pacific Preparedness Team that has begun to coordinate preparedness efforts. The group has hosted several virtual workshops focusing on preparedness, surveillance, and intervention, and published [SCTLD Surveillance Guidelines for the Indo-Pacific](#). However, increased support for Pacific preparedness is needed given what is at stake. **Thus, this goal includes a number of activities focused on sharing information, best practices, and technologies to help support the development of preparedness and response plans.**

Coordinate exchange of information, personnel, and best practices between Atlantic and Indo-Pacific MPAs and other local jurisdictions.

Activity 1: Partnerships with Regional Networks (\$3,000)

Identify relevant established regional networks and initiatives and reach out to develop specific partnership opportunities that will enable increased cooperation and coordination on SCTLD prevention, response, and preparedness and improved SCTLD information exchange.

Activity 2: SCTLD Preparedness in the U.S. Indo-Pacific (\$93,000, priority)

Support SCTLD preparedness in the U.S. Indo-Pacific by 1) fostering the development and ongoing coordination of a Pacific Coral Disease Network to facilitate communication, collaboration, training, and sharing of resources among Pacific jurisdictions, Freely Associated States, and marine protected areas in the U.S. Indo-Pacific; 2) retooling existing communications resources and materials (developed for the Caribbean by MPAConnect/Atlantic and Gulf Rapid Reef Assessment) for the Pacific; and 3) facilitating the development of an SCTLD response planning toolkit to assist coral reef resource managers in unaffected U.S. jurisdictions as well as international locations in preparing for strategic responses to coral disease outbreaks.

Activity 3: Interjurisdictional Collaborative Workshops (\$375,000)

Support regular workshops to facilitate collaboration and information exchange among jurisdictions and regional partners. This activity would provide continued support for an annual U.S. Regional Caribbean SCTL D Workshop to coordinate information exchange among affected areas to improve responses. It would also support opportunities to share lessons learned with unaffected Pacific jurisdictions to inform SCTL D response preparedness planning efforts.

Support workshops and training sessions to increase capacity for communication, detection of and monitoring for SCTL D.

Activity 1: Pacific Preparedness Workshops and Trainings (\$330,000, priority)

Implement a series of workshops and trainings in unaffected Pacific jurisdictions, including field, classroom-based, and virtual training. These workshops and trainings will focus on SCTL D preparedness and increasing capacity for communication, prevention, surveillance, response, rescue, and restoration by including information and lessons learned from the Atlantic/Caribbean region.

Activity 2: Engaging Sea Grant Programs in SCTL D Response and Prevention (\$200,000)

Engage individual Sea Grant programs in the implementation of jurisdictional SCTL D response and preparedness plans. Sea Grant programs have vast expertise in communications, outreach, education, citizen science, science interpretation, and more, and would be able to leverage this knowledge in SCTL D planning and response. By engaging individual Sea Grant programs to collaborate on the needs of each jurisdiction, planning and response needs may be tailored to local areas.

Support the development and/or updating of jurisdiction-specific response plans.

Activity 1: Annual Response Planning Workshops for Affected Jurisdictions (\$225,000)

In affected jurisdictions (Florida, U.S. Virgin Islands, Puerto Rico), implement annual workshops to update jurisdiction-specific response plans and surveillance protocols.

Activity 2: Preparedness and Surveillance Planning—Unaffected Jurisdictions (\$360,000, priority)

Unaffected Jurisdictions: In unaffected jurisdictions (Hawai'i, American Samoa, Guam, Commonwealth of the Northern Mariana Islands), facilitate the development of SCTL D response and preparedness plans and surveillance protocols. Update content in preparedness plans with new information if applicable.

Institute surveillance protocols to provide early warning and track disease progression.

Activity 1: Monitoring and Surveillance for SCTL D in Affected and Unaffected Jurisdictions (\$1,180,000, priority)

Provide support for integrating SCTL D monitoring and surveillance into jurisdictional coral reef monitoring programs via trainings and workshops; provide resources for surveillance and monitoring activities; and integrate SCTL D monitoring and surveillance into National Coral Reef Monitoring Program (NCRMP) protocols.

Activity 2: Pacific Coral Disease Dashboard and Information Portal (\$155,000)

Develop and maintain a coral disease monitoring dashboard and information portal for the U.S. Indo-Pacific Region to provide a mechanism for the submission, review, and sharing of coral disease observations and data.

Scale NOAA capacity to respond to and treat affected coral in U.S. coral jurisdictions.

Activity 1: NOAA SCTLD Response Gap Analysis (\$200,000)

Conduct a gap analysis to determine where NOAA human resource capacity for local response to SCTLD exists and where additional NOAA capacity is needed. Provide additional NOAA staff (federal and contract) time as needed to support gaps.

Activity 2: Guidelines for Environmental Compliance Review of NOAA-funded SCTLD Projects (\$0)

Collaborate with other agencies via the U.S. Coral Reef Task Force Coral Disease Working Group to streamline permitting and environmental consultation processes for NOAA-funded coral disease related projects and initiatives. This could be done through programmatic options or clear step-by-step process guides for each jurisdiction.

Activity 3: Treatment and Intervention in Affected Jurisdictions (\$1,500,000, priority)

Increase NOAA investment (funding and personnel) in treatment and intervention in affected jurisdictions.

Activity 4: NOAA Diver Decontamination Protocols (\$0)

Ensure NOAA divers and NOAA-funded projects institute decontamination protocols to prevent spread.

Activity 5: National Coral Disease Coordination Capacity (\$1,350,000, priority)

Support a national coral disease coordinator, coral disease associate, and student intern to provide leadership and coordination to the U.S. national response to SCTLD across all currently affected and vulnerable jurisdictions. The positions will ensure effective coordination among federal agencies and facilitate communications, identify information and resource gaps, and efficiently allocate federal resources to ensure that the response is managed in a strategic, coherent and holistic manner. These positions will also provide coordination to the implementation of this plan as well as track the progress of project activities and impacts.

Activity 6: Disease Response in Flower Garden Banks National Marine Sanctuary (\$625,000)

Provide resources to support monitoring, intervention, and coral rescue in Flower Garden Banks National Marine Sanctuary.

Support citizen science-based reporting systems to increase spatial awareness of SCTLD.

Activity 1: Supporting Citizen Science in Jurisdictions (\$245,000)

Coordinate with individual states and territories to assess needs that relate to citizen science monitoring, using the information generated to produce jurisdiction-specific citizen science action plans that can be incorporated into overall response and preparedness plans. Implement activities in the action plans.



Citizen scientists can help identify and treat stony coral tissue loss disease and that data can be used by researchers. Photo credit: Karen Neely.

Goal 3: Support coral rescue, propagation, and restoration operations, research and partnerships across the U.S. to preserve the genetic diversity of corals necessary for future restoration efforts and support reef health. (\$36,750,000)

Given the high levels of mortality from SCTLD, an essential recovery step is coral rescue, which focuses on the preservation of coral genetic diversity for coral restoration. Coral rescue initiatives developed and implemented in different jurisdictions are unique, accounting for differences in restoration goals and available resources. The Florida Coral Rescue Program is focused on collecting, or rescuing, healthy corals ahead of the disease front to preserve coral genetic diversity and ensure the success of future restoration activities along Florida's Coral Reef. Through an innovative partnership with the Association of Zoos and Aquariums, rescued corals are housed in land-based coral nurseries. The U.S. Virgin Islands coral rescue program, led by Coral World Ocean and Reef Initiative and the University of the Virgin Islands, focuses on removing sick corals with active SCTLD lesions from the reef and treating and rehabilitating them in land-based nurseries at Coral World on St. Thomas. These corals will remain at Coral World for preserving genetic material, breeding, and outplanting purposes. In Puerto Rico, managers are developing a strategy to guide coral rescue efforts, which will identify criteria to decide which coral species to prioritize in rescue and restoration efforts and highlight the need to expand land-based nursery capacity throughout the island.

Despite advances in coral rescue in the U.S. Caribbean, additional support is needed to increase capacity for these efforts. The U.S. Virgin Islands and Puerto Rico have agreed to collaborate at the regional level to help leverage expertise and resources. The activities proposed in the implementation plan will support regional-level collaboration, bringing increased resources to the U.S. Caribbean to enhance coral rescue capacity and technical expertise.

Establish a U.S. Caribbean coral rescue effort.

Activity 1: Coral Rescue Coordinator (\$900,000, priority)

Due to the scale and complexity of proposed U.S. Caribbean coral rescue efforts, a central coordinator is required. This coordinator will lead the efforts to plan and execute coral rescue activities in the U.S. Virgin Islands and Puerto Rico, drawing on lessons from Florida coral rescue efforts and other genetic rescue, captive breeding, and species recovery efforts.

Activity 2: U.S. Caribbean Coral Rescue Workshop (\$80,000)

Convene a workshop to plan a U.S. Caribbean coral rescue effort, including discussions on leadership and coordination of the effort, partner roles and responsibilities, and capacity of existing coral nurseries and/or aquaria. Workshop participants will consider alternate strategies for coral rescue operations, including whether a new, multi-jurisdictional facility is feasible and developing an assisted reproduction project by collecting gametes of highly susceptible species.

Activity 3: Establishment of Land-Based Coral Nurseries (\$28,200,000, priority)

Work with partner organizations to establish and maintain new land-based coral nurseries in the U.S. Caribbean that can house rescued corals and support future restoration efforts for coral reefs that have been impacted by SCTLD.

Activity 4: Technical Assistance for Rescue, Propagation, and Restoration (\$7,300,000)

Provide technical assistance in planning and/or executing coral rescue, propagation, and restoration activities. This may include the development of regional best management practices, as warranted and appropriate.

Activity 5: Coral Rescue and Restoration Database (\$270,000)

Develop a standardized comprehensive coral rescue and restoration database that tracks individual genotypes through the entire process of rescue, rehabilitation, husbandry, fragmentation, and outplanting.

Goal 4: Promote awareness of SCTLD science, status, and indicators. (\$485,000)

Continued work to promote awareness of SCTLD and its lasting impacts on coral reefs among existing and new partners is greatly needed. While individual jurisdictions have a communications component as part of their disease response structure, an increased focus on consistent communications at the national level will help enhance understanding of SCTLD and the need for sustained response and prevention efforts. Activities under this goal propose to develop a national-level communications strategy that will help increase collaboration among local efforts and develop consistent messaging and communications products. This goal also includes a continued focus on the U.S. Coral Reef Task Force and its importance as a framework for promoting coordination and collaboration among many federal, state, and territorial agencies.

Partner with regional networks, initiatives, reef managers, and community leaders to develop and distribute resources to increase awareness and understanding of SCTLD.

Activity 1: National SCTLD Communications Strategy (\$30,000, priority)

Develop a national level communications strategy and associated resources including messaging, social marketing, newsletters, and materials to target stakeholder groups.

Activity 2: Jurisdiction Communications and Outreach Plans (\$150,000)

Develop, update, and implement jurisdiction-specific communications and outreach plans in jurisdictions affected by SCTLD.

Activity 3: SCTLD Newsletter and Monthly Updates (\$40,000)

Regularly share relevant updates, resources, trainings, and research among a broad SCTLD community via a semi-annual newsletter and monthly digital updates. Ensure all updates and resources are readily available online.

Activity 4: Annual SCTLD Report (\$15,000)

Produce an annual report focused on SCTLD in U.S. waters, including the status of the disease, overview of jurisdictional response efforts, and national and regional coordination actions and accomplishments.

Work with other federal agencies on the U.S. Coral Reef Task Force to ensure SCTLD awareness and to facilitate its consideration in federal decision-making.

Activity 1: U.S. Coral Reef Task Force Coral Disease Working Group (\$250,000, priority)

Use the U.S. Coral Reef Task Force Coral Disease Working Group to facilitate effective collaboration and communication on coral disease status and response efforts among federal agencies, U.S. States and Territories, and Freely Associated States; build capacity for coral disease prevention, preparedness, and response; and prevent the further transmission of SCTLD.

Goal 5: Collaborate with the coral reef management community to reduce stressors to coral reefs and build ecosystem resilience. (\$0)

While SCTLD is a novel and unprecedented event, coral disease outbreaks have been increasing in frequency and severity in recent years. Long-term, chronic stressors like climate change, worsening water quality, and unsustainable fishing have had a huge impact on the health of coral reefs in recent decades. It is likely that declining ecosystem health has made corals more susceptible to diseases like SCTLD. SCTLD was first detected along Florida's Coral Reef in 2014; since that time, it has spread rapidly along the entirety of Florida's Coral Reef and throughout the broader Caribbean. It is now endemic in many coral reef ecosystems and response is transitioning from emergency response to long-term management. SCTLD must be incorporated into long-term coral management programs and restoration planning. Coral disease must also be communicated as a persistent and growing threat to coral reefs, along with other long-term stressors like climate change, coral bleaching, marine debris, and unsustainable fishing. While other activities in this implementation plan focus on enhancing SCTLD-specific restoration, actions under this goal focus on incorporating species impacted by SCTLD into existing, long-term restoration efforts.

Improve coral reef habitat quality and restore ecosystem function.

Activity 1: Communicating Coral Disease as a Threat (\$0)

Ensure that coral reef management and conservation programs at both the jurisdictional and national levels include SCTLD and coral disease as a threat to coral reefs when communicating to the public about coral reef health and conservation. Disease should be included as one of the many threats that work in concert to degrade the health and sustainability of coral reef ecosystems.

Activity 2: Integrating Coral Disease into Restoration Plans (\$0, priority)

Integrate SCTLD and coral disease into jurisdictional coral restoration plans.



Local, regional, and national collaborations improve the response to SCTLD. Photo credit: NOAA.

Goal 6: Use the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act and Section 7 Endangered Species Act consultations to ensure SCTLD is evaluated as part of the baseline environmental conditions, in addition to environmental consequences and cumulative impacts that may result from federal actions. (\$90,000)

Seven coral species are designated as threatened under the Endangered Species Act (ESA) in the Caribbean, four of which are susceptible to SCTLD. Under the ESA, federal agencies must consult with the National Marine Fisheries Service (NMFS) when any project or action they take might affect an ESA-listed marine species or designated critical habitat. As part of the consultation process, NMFS identifies reasonable and prudent measures that are designed to minimize effects of projects on ESA-listed species and designated critical habitat.

Essential Fish Habitat (EFH) is defined in the Magnuson-Stevens Act as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity," which include corals, coral reefs, and hard bottom habitats. Federal agencies which fund, permit, or carry out activities that may adversely affect EFH are required to consult with NMFS regarding the potential impacts of their actions on EFH. EFH consultations focus on sequential mitigation: avoid impacts first, then minimize unavoidable impacts, and conduct compensatory mitigation for unavoidable impacts.

Compensatory mitigation, which occurs under the Magnuson-Stevens Act, and reasonable and prudent measures in biological opinions, occurring under the ESA, can include measures to restore coral reefs and/or reduce the impact of SCTLD through interventions (e.g., probiotic applications or SCTLD treatments). It is imperative that mitigation planning reflects the best available practices pertaining to interventions and restoration in light of SCTLD that are being developed by the coral science and restoration community. Activities under this priority goal and objective are designed to incorporate the best available scientific information related to infection and spread of SCTLD, monitoring and detection of SCTLD related to coastal construction projects, developing best practices for mitigation and restoration in light of SCTLD, and sharing information among federal agencies.

Ensure that mitigation activities that result from consultations reflect SCTLD intervention and restoration best practices.

Activity 1: Integrate Sediment Research Findings into Avoidance Strategies for Coastal Construction Projects (\$0)

Because SCTLD is a relatively new disease, there is still much to learn about disease dynamics, including factors that contribute to disease transmission and coral susceptibility. As scientific understanding of SCTLD continues to improve, there is a need to incorporate research findings into construction project consultations to ensure that projects and associated mitigation are conducted in a manner that will avoid and minimize the likelihood of SCTLD infection and spread. This activity will integrate research findings, particularly those identified under Goal 1 of this implementation plan, into project consultations to minimize the potential for SCTLD infection and spread related to dredging projects.

Activity 2: SOPs for SCTLD Monitoring Before and During Coastal Development Activities (\$30,000, priority)

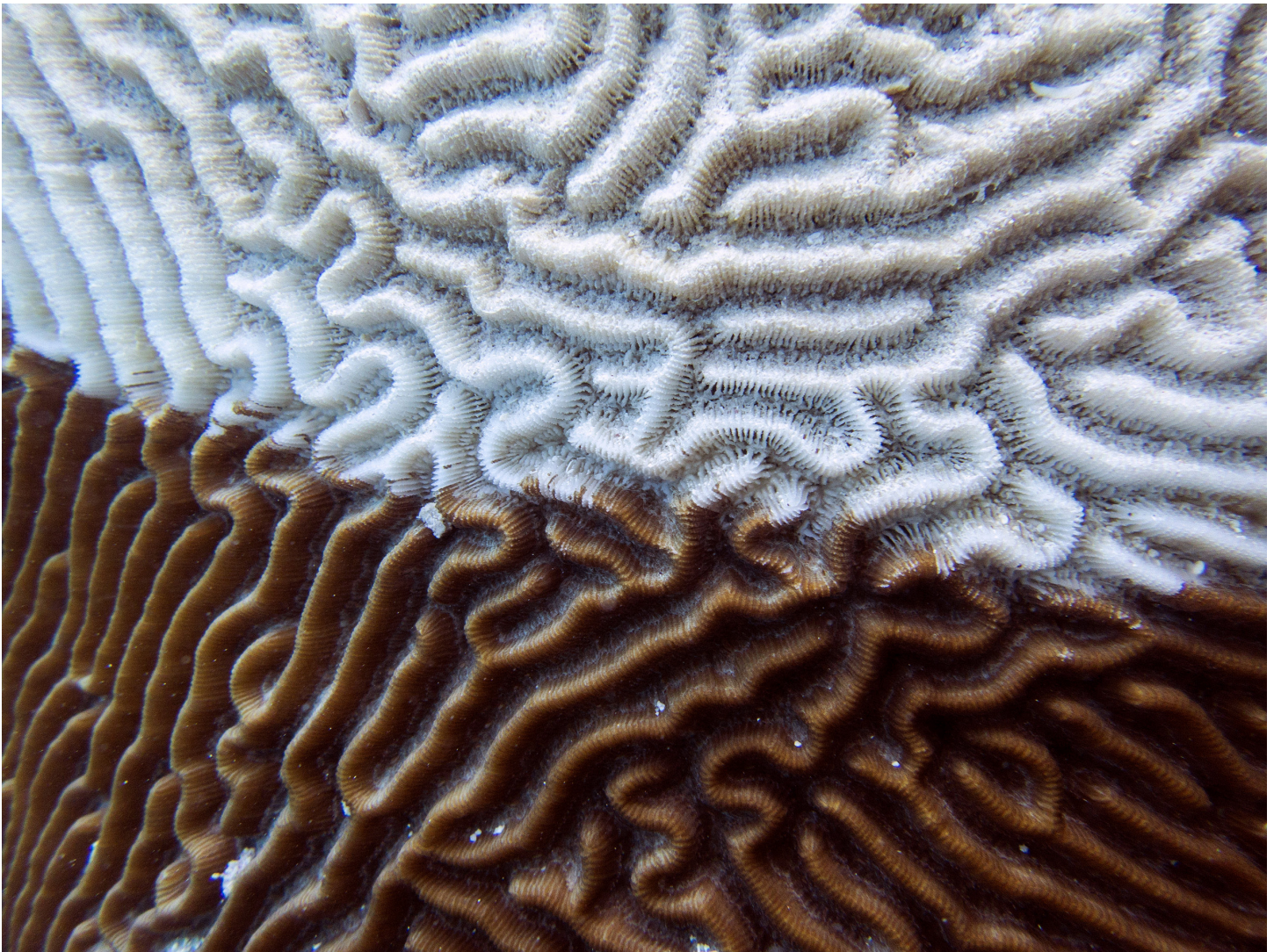
Develop standard operating procedures (SOPs) for monitoring SCTLD prevalence before and during coastal development activities (e.g., dredging) that cause sediment suspension and transport in the water column. Develop the acceptable limits of change in SCTLD prevalence and identify SCTLD conditions requiring corrective actions to the coastal development activity to prevent or minimize SCTLD spread. Implement or support the implementation of the SOPs at priority coastal development project sites.

Activity 3: SCTLD Best Management Practices for Mitigation (\$60,000)

Based on what we know and learn about SCTLD, develop best management practices (BMPs) for mitigation, including compensatory mitigation (e.g., timing, siting, preferred species, density), and update BMPs as needed. BMPs are tailored to disease zones (e.g., endemic vs pre-invasion), jurisdictions (e.g., Florida vs. the U.S. Virgin Islands), and intervention strategies, in case outbreaks occur during mitigation implementation.

Activity 4: Increase Engagement Between SCTLD Scientists and Regulators (\$0)

Increase opportunities for engagement between SCTLD scientists, regulators, and project proponents, ensuring that a representative from the U.S. Army Corps of Engineers (USACE) serves on the U.S. Coral Reef Task Force Coral Disease Working Group and that SCTLD communications are distributed to the USACE.



A close up of stony coral tissue loss disease on a brain coral. Increased engagement between scientists and regulators will lead to better informed decision-making. Photo credit: Olivia Williamson.

Goal 7: Strengthen and expand international partnerships for SCTLD surveillance and sharing of data, best practices, and resources. (\$955,000)

In response to the emergence of SCTLD along American reefs, coral reef managers developed robust, collaborative, and innovative disease response networks and protocols. Florida's disease response structure includes a Caribbean Cooperation Team, which serves as the primary vehicle for Caribbean coral managers and practitioners to connect and share information about the disease. It also serves as a conduit for capacity building, supporting regional-level organizations that participate on the Team, including MPAConnect, Gulf & Caribbean Fisheries Institute, Atlantic & Gulf Rapid Reef Assessment, The Nature Conservancy, the Smithsonian Institution's Healthy Reefs Initiative, and the United Nations Environmental Program Caribbean Environment Program. NOAA has the ability and the expertise to help prepare unaffected jurisdictions for an SCTLD outbreak and facilitate ongoing communication and information exchange. Enhancing support for regional partners and international jurisdictions is essential to effectively managing the disease over the long-term and ensuring the resiliency and health of coral reefs throughout the region.

Prepare unaffected international jurisdictions for surveillance and intervention response.

Activity 1: Incorporating SCTLD into the International Coral Reef Initiative (ICRI) (\$15,000)

Incorporate SCTLD efforts, needs, and capacity building into the ICRI platform to raise awareness of SCTLD and share information on coral disease preparedness and response.

Increase international capacity for and coordination of surveillance, data collection, rescue, communications, and response planning.

Activity 1: Coordination of Caribbean Cooperation Team (\$100,000)

Provide leadership and coordination support for the SCTLD Caribbean Cooperation Team and partner with regional organizations to track disease spread and distribute information; share lessons learned from ongoing response efforts including intervention and treatment techniques; share key informational products for distribution in the region; build capacity for SCTLD detection and response in the region; and identify potential resources to support detection and response activities in the Caribbean region.

Activity 2: International Caribbean Coral Rescue(\$40,000)

Provide training and technical assistance to support the development and implementation of international coral reef rescue initiatives to support future coral propagation and restoration efforts in places that have been impacted by SCTLD.

Activity 3: SCTLD Training and Technical Assistance for the International Caribbean (\$800,000, priority)

Work with regional partner organizations and initiatives including AGRRA, MPAConnect and the SCTLD Caribbean Cooperation Team to provide information, training and technical assistance for Caribbean jurisdictions to support their efforts to monitor coral reefs for SCTLD, and to prepare for and respond to SCTLD outbreaks.

Goal 8: Work with relevant partners to prevent the spread of SCTLD to the four U.S. coral reef jurisdictions and Freely Associated States in the Indo-Pacific region. (\$25,000)

SCTLD has not yet been detected in the Indo-Pacific region and the likelihood of the spread of the disease into the Pacific basin is unknown. However, the emergence of SCTLD on Pacific reefs could potentially be catastrophic. Thus, it is of critical importance to employ strategies to prevent further disease transmission. Many activities to mitigate the spread of the disease are currently underway, led by the U.S. Coast Guard and Environmental Protection Agency (EPA). In 2019, the EPA conducted a study investigating the potential relationship between ballast water discharge and the spread of SCTLD. The same year, the U.S. Coast Guard released a Marine Safety Information Bulletin to the commercial shipping community reminding mariners of mandatory ballast water management protocols and promoting voluntary best management practices (BMPs) designed to help reduce the potential threat of SCTLD transmission via ballast water discharge. The Coast Guard has also convened an SCTLD Task Force dedicated to increasing compliance with ballast water discharge regulations and creating a risk profile identifying high-risk vessels transiting from the Atlantic/Caribbean to the Pacific.

In order to protect reefs in the Indo-Pacific region, it is critical to sustain and expand these approaches. Best management practices should continue to be updated based on new information emerging from research and disseminated broadly among the shipping community. Domestic, regional, and international partnerships should be expanded to increase awareness about SCTLD and the implementation of measures to prevent transmission. Activities for this goal include a focus on the continued dissemination of BMPs, building partnerships, and enhancing regulatory compliance to prevent the continued spread of SCTLD.

Continue to promote best management practices for ballast water treatment with the maritime industry domestically and internationally, and continue support for research on the connection between ballast water treatment and other sea systems.

Activity 1: Ballast Water Best Management Practices (\$0, priority)

Provide recommendations for the development, revision, and promotion of best management practices (BMPs) and ballast water treatment based on current and emerging research on transmission of SCTLD in ballast water. Ensure the BMPs are consistent with the Vessel Incidental Discharge Act (VIDA).

Activity 2: Building Partnerships for Ballast Water Management (\$25,000, priority)

Collaborate with existing regional and international institutions - such as the International Maritime Organization, the International Ballast Water Management Convention, and both the National and Regional Invasive Species Councils - to disseminate existing and future SCTLD BMPs, promote regional collaboration on SCTLD, and develop and implement regional approaches to prevention (i.e., Caribbean countries could strengthen regional requirements under the International Ballast Water Management Convention).

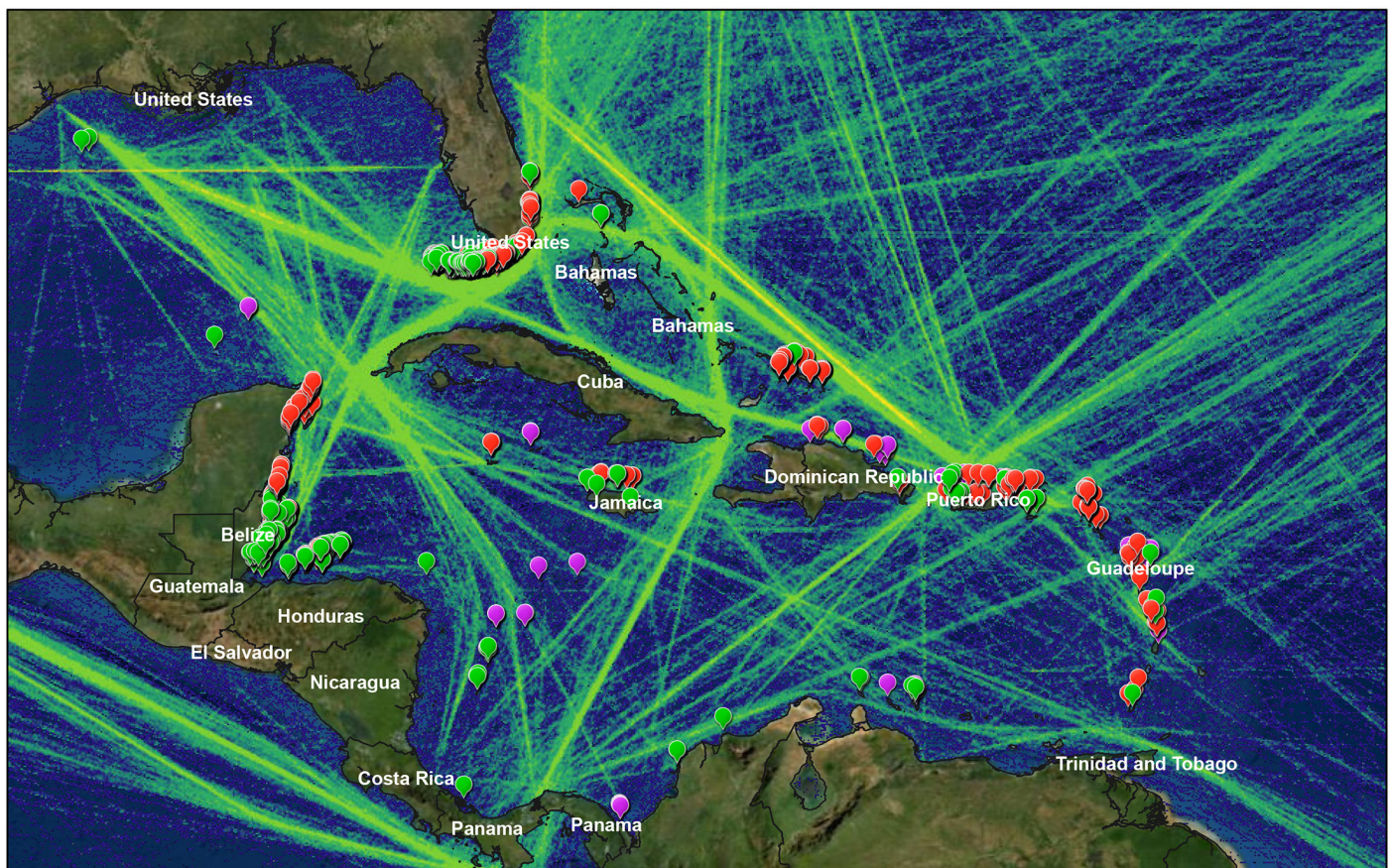
Work with the EPA, U.S. Coast Guard and jurisdictional environmental enforcement authorities to promote active enforcement of existing regulations as they pertain to ballast water discharge²⁰ under current regulations and future regulations under the Vessel Incidental Discharge Act (VIDA).

Activity 1: Enhance Maritime Transportation Compliance with Existing Regulatory Requirements to Prevent SCTLD Transmission (\$0)

Evaluate existing regulatory requirements and use available legal frameworks across federal agencies to prevent SCTLD transport from the Caribbean to Pacific, ensuring vessels meet existing regulatory requirements and determining if additional steps may be taken under emergency provisions.

Activity 2: Understanding VIDA's Implications for SCTLD (\$0)

Once the Vessel Incidental Discharge Act (VIDA) is enacted, evaluate the implications of new regulations on SCTLD transmission and support the development of agency-level guidelines that implement VIDA rules and regulations in a manner that minimizes SCTLD transmission.



August 17, 2022

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Benjamin Halpern, Melanie Frazier, John Potapenko, Kenneth Casey, Kellee Koenig, et al. 2015. Cumulative human impacts: raw stressor data (2008 and

Map of current SCTLD spread (dropped pins) overlaid with shipping routes (yellow-green lines). Ballast water and ports could potentially transmit SCTLD to other areas. Map from <https://www.agrra.org/coral-disease-outbreak/>

References

1. Brander, L.M., & Van Beukering, P. (2013). The Total Economic Value of U.S. Coral Reefs: A Review of the Literature. NOAA Coral Reef Conservation Program. Silver Spring, MD. 32 p. https://data.nodc.noaa.gov/coris/library/NOAA/CRCP/other/other_crpc_publications/TEV_US_Coral_Reefs_Literature_Review_2013.pdf
2. Florida Keys National Marine Sanctuary. (2011). Coral reefs support jobs, tourism, and fisheries. <https://floridakeys.noaa.gov/corals/economy.html>
3. National Oceanic and Atmospheric Administration. (2019). Coral Reef Ecosystems. <https://www.noaa.gov/education/resource-collections/marine-life/coral-reef-ecosystems>
4. Maynard J., Van Hooidonk, R., Eakin, C.M., Puotinen, M., Garren, M., Williams, G., Heron, S.F., Lamb, J., Weil, E., Willis, B. & Harvell, C.D., (2015). Projections of climate conditions that increase coral disease susceptibility and pathogen abundance and virulence. *Nature Climate Change* 5, 688-694. <https://doi.org/10.1038/nclimate2625>
5. Landsberg, J.H., Kiryu Y., Peters, E.C., Wilson, P.W., Perry, N., Waters, Y., Maxwell, K.E., Huebner, L.K., & Work, T.M. (2020). Stony coral tissue loss disease in Florida is associated with disruption of host-zooxanthellae physiology. *Frontiers in Marine Science*, 7, 576013. <https://doi.org/10.3389/fmars.2020.576013>
6. Meiling, S. S., Muller, E. M., Lasseigne, D., Rossin, A., Veglia, A. J., MacKnight, N., Dimos, B., Huntley, N., Correa, A.M.S., Smith, T.B., Holstein, D.M., Mydlarz, L.D., Apprill, A., & Brandt, M. E. (2021). Variable species responses to experimental stony coral tissue loss disease (SCTLD) exposure. *Frontiers in Marine Science*, 464. <https://doi.org/10.3389/fmars.2021.670829>
7. Work T.M., Weatherby T.M., Landsberg J.H., Kiryu Y., Cook S.M., Peters E.C. (2021). Viral-like particles are associated with endosymbiont pathology in Florida corals affected by stony coral tissue loss disease. *Frontiers in Marine Science*, 8, 750658. <https://doi.org/10.3389/fmars.2021.750658>
8. Meyer, J. L., Castellanos-Gell, J., Aeby, G. S., Häse, C. C., Ushijima, B., & Paul, V. J. (2019). Microbial community shifts associated with the ongoing stony coral tissue loss disease outbreak on the Florida Reef Tract. *Frontiers in Microbiology*, 2244. <https://doi.org/10.3389/fmicb.2019.02244>
9. Rosales, S.M., Clark, A.S., Huebner, L.K., Ruzicka, R.R., & Muller, E.M. (2020). Rhodobacterales and Rhizobiales are associated with stony coral tissue loss disease and its suspected sources of transmission. *Frontiers in Microbiology*, 11, 681. <https://doi.org/10.3389/fmicb.2020.00681>
10. Iwanowicz, D. D., Schill, W. B., Woodley, C. M., Bruckner, A., Neely, K., & Briggs, K. M. (2020). Exploring the Stony Coral Tissue Loss Disease Bacterial Pathobiome. *BioRxiv*. <https://doi.org/10.1101/2020.05.27.120469>
11. Vardi, T., Rankin T.L., Oliver T., Moulding A., Parrish F., Moore T., Enochs I., Viehman T.S., & Koss J.L. (2020). NOAA Action Plan on Coral Interventions. NOAA Tech. Memo. NMFS-F/SPO-208, <https://doi.org/10.25923/weyp-fy32>
12. Skrivaneck, A., & Wusinich-Mendez, D. (2020). NOAA Strategy for Stony Coral Tissue Loss Disease Response and Prevention. https://coast.noaa.gov/data/coralreef_noaa_gov/media/docs/NOAA_SCTLD_Strategy_2020.pdf
13. Studivan, M.S., Baptist, M., Molina, V., Riley, S., First, M., Soderberg, S., Rubin, E., Rossin, A., Holstein, D., & Enochs, I. (2022) PREPRINT (Version 1). Transmission of stony coral tissue loss disease (SCTLD) in simulated ballast water confirms the potential for ship-born spread. *Scientific Reports*. <https://doi.org/10.21203/rs.3.rs-1720701/v1>

14. Aeby, G. S., Ushijima, B., Campbell, J. E., Jones, S., Williams, G. J., Meyer, J. L., Hase, C., & Paul, V. J. (2019). Pathogenesis of a tissue loss disease affecting multiple species of corals along the Florida Reef Tract. *Frontiers in Marine Science*, 6, 678. <https://doi.org/10.3389/fmars.2019.00678>
15. Dobbelaere, T., Holstein, D. M., Muller, E. M., Gramer, L. J., McEachron, L., Williams, S. D., & Hanert, E. (2022). Connecting the dots: Transmission of stony coral tissue loss disease from the Marquesas to the Dry Tortugas. *Frontiers in Marine Science*, 80. <https://www.frontiersin.org/articles/10.3389/fmars.2022.778938/full>
16. Dobbelaere, T., Muller, E. M., Gramer, L. J., Holstein, D. M., & Hanert, E. (2020). Coupled epidemio-hydrodynamic modeling to understand the spread of a deadly coral disease in Florida. *Frontiers in Marine Science*, 7, 591881. <https://doi.org/10.3389/fmars.2020.591881>
17. Muller, E. M., Sartor, C., Alcaraz, N. I., & Van Woesik, R. (2020). Spatial epidemiology of the stony-coral-tissue-loss disease in Florida. *Frontiers in Marine Science*, 7, 163. <https://doi.org/10.3389/fmars.2020.00163>
18. Sharp, W. C., Shea, C. P., Maxwell, K. E., Muller, E. M., & Hunt, J. H. (2020). Evaluating the small-scale epidemiology of the stony-coral-tissue-loss-disease in the middle Florida Keys. *PLoS One*, 15(11), e0241871. <https://doi.org/10.1371/journal.pone.0241871>
19. Studivan, M. S., Rossin, A. M., Rubin, E., Soderberg, N., Holstein, D. M., & Enochs, I. C. (2022). Reef sediments can act as a stony coral tissue loss disease vector. *Frontiers in Marine Science*, 2046. <https://doi.org/10.3389/fmars.2021.815698>
20. United States Coast Guard (2019). Ballast water best management practices to reduce the likelihood of transporting pathogens that may spread stony coral tissue loss disease. *Marine Safety Information Bulletin*, 6, 07–19. [https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/MSIB/2019/MSIB_007_19. pdf?ver=2019-09-06-151207-643](https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/MSIB/2019/MSIB_007_19.pdf?ver=2019-09-06-151207-643)



Appendix I: Detailed activities

Detailed activities for each of the objectives listed in the implementation plan.

Goal 1: Expand capacity for research and data collection on SCTLD

Objective 1b: Identify data gaps and sampling needs.

Activity 1: Research Audit & Synthesis

Conduct a research audit that collates information on completed, ongoing, and new projects related to SCTLD within Florida and the Caribbean. The main outcome will be a populated data portal with search and data archiving capabilities for existing and future data and metadata of SCTLD research studies and intervention efforts. It will include fields such as species evaluated and locations, hypotheses tested or generated, and general conclusions.

Activity Lead

NOAA National Centers for Coastal Ocean Science

Potential Activity Partners

Florida Disease Advisory Committee, Florida Fish and Wildlife Conservation Commission, Coral Reef Conservation Program, National Environmental Satellite Data Information Science, National Centers for Coastal Ocean Science

Budget

Year 1: \$275,000 (contractor staff time, database costs, workshop)

Year 2: \$350,000 (contractor staff time, web interface/dashboard development for data access from National Database, workshop)

Year 3: \$150,000 (workshops)

Year 4: \$150,000 (workshops)

Year 5: \$150,000 (workshops)

Total: \$1,075,000

Potential Funding Sources

NOAA, Florida Fish and Wildlife Conservation Commission, United States Geological Survey

Description of Efforts

Establish a searchable database framework to capture retrospective and prospective research activities, samples, metadata, and data nationally and internationally to support ongoing SCTLD response, intervention, and preparedness priorities.

Catalog SCTLD research, surveillance, and intervention activities into a searchable format (completed, ongoing, and planned), capturing information related to species, data and its accessibility, and archived samples that exist, including type and preservation method. This should include research/knowledge existing within the four Florida Research and Epidemiology sub-teams (histopathology, coral immune health and 'omics, pathogen identification and microbiome characterization, and environmental factors and transmission).

Identify and predict potential bottlenecks delaying or hindering research, response, intervention and/or prevention progress (i.e., a backlog of histology samples that need to be processed, additional analysis of existing data, or location of relevant samples).

Host annual workshops to bring together internal SCTLD experts and external partners to evaluate existing data and data gaps and to identify a path forward. The first year's workshop will bring together a small sub-team focused on pulling together information necessary for subsequent workshops that will include external experts. Workshops in years two through five will include external disease experts and SCTLD experts and will focus on identifying data gaps, determining future priorities, and comparing SCTLD response to other disease outbreak responses.

Timeline

Year 1: Hire subject matter expert contractor to interface with researchers to identify and collect metadata; assist researchers in data-entry into national database; develop an instructional document to assist researchers in data entry and/or links to data and metadata to comply with new project requirements for data accessibility; host workshop with a small sub-team to define research gaps and priorities

Year 2: Contract for development of a web-interface to search, access and download archived data/metadata; subject matter expert to complete archiving of SCTL D data/metadata to include national and internationally available data; host workshop with external experts to synthesize state of field and identify research gaps

Years 3-5: Host annual workshops with external experts that build on outcomes of previous workshops

Measurable Outcomes

1. Searchable database of SCTL D metadata and data
2. Database populated with available retrospective SCTL D QA metadata and data
3. User friendly web-interface (or dashboard) to facilitate searches and data retrieval with summary analytic tools
4. Number of participants/subject matter experts attending workshops
5. Identification of a path forward to fill data gaps
6. Number of new multidisciplinary partnerships

Activity 2: Standard Operating Procedures for Sample/Data Collection/Intervention

Develop standard operating procedures (SOPs) that support landscape epidemiology and include: 1) data collection and monitoring related to disease, environmental, and ecological data that are needed for calculating epidemiological parameters (e.g., prevalence, incidence, incidence rate, mortality rate, case fatality, survival) and necessary for regional comparisons, 2) sample collection related to coral biopsies and reservoirs of disease (e.g., water, sediment), and 3) disease intervention approaches (e.g., antibiotic application, probiotic treatment) that includes assessment measurements appropriate for determining effectiveness. The development and application of these SOPs will support epidemiological investigations, allow for regional comparisons of disease dynamics (e.g., patterns of disease occurrence), and assist in understanding disease and environmental risk factors involved in driving the spread, transmission, and maintenance of disease in populations.

Activity Lead

Florida Keys National Marine Sanctuary

Potential Activity Partners

NOAA Coral Reef Conservation Program, United States Geological Survey, Environmental Protection Agency, state and territorial government partners

Budget

Year 1: \$300,000
 Year 2: \$300,000
 Year 3: \$300,000
 Year 4: \$100,000
 Year 5: \$100,000
 Total: \$1,100,000

Potential Funding Sources

NOAA, Environmental Protection Agency, Coast Guard, United States Geological Survey, non-governmental organizations

Description of Efforts

Standardizing protocols in disease surveillance and response efforts is critical to enable early detection of potential SCTLD outbreaks and verification. Standardized guidelines provide a roadmap to act in a coordinated and effective manner that will support cross-jurisdictional communication, comprehensive disease analytics, and environmental health-management decisions. To accomplish this will require the development of three pivotal guidelines that provide clear rationales and instructions. Companion activities to written guideline documents will be training workshops and instructional videos. The hands-on training workshops will provide surveillance and response teams practical knowledge in executing the protocols. Training videos will be designed as supplementary and refresher materials for the guidelines. To ensure readiness and compliance with the guidance, simulation exercises and regular drills will be developed and implemented across jurisdictions. In addition, an instructive, narrated video guide to identifying coral species and common afflictions that can be encountered in the field will be developed, recognizing and distinguishing among disease, predation, and physical damage.

Timeline

Year 1: Develop in-water video for disease identification in Caribbean (develop storyboard, acquire underwater video and audio); identify database architecture, user interface for uploading data and analytics for drawing meaning from the data; protocols for data collection and surveillance/monitoring; protocols for specimen collections; protocols for disease intervention

Year 2: Conduct training workshops in proper execution of the protocols in Pacific and Caribbean

Year 3: Develop in-water video for disease identification in Pacific; develop simulation scenarios and drills for readiness

Year 4: Conduct preparedness and readiness drills for Pacific

Year 5: Conduct preparedness and readiness drills for Atlantic/Caribbean

Measurable Outcomes

1. Published guidelines on NOAA websites (e.g., Coral Reef Conservation Program, Coral Disease and Health Consortium) and distributed to all surveillance and response teams
2. Narrated videos for distinguishing coral disease in the field
3. Narrated videos of how-to execute guidelines for data collection and surveillance/monitoring for coral disease outbreak responses
4. Narrated videos of how-to execute guidelines for collection of clinical specimens in coral disease outbreak investigations
5. Narrated videos of how-to execute disease intervention approaches

Objective 1c: Explore alternative treatment options, such as probiotics and other colony- and reef-level treatments.

Activity 1: Direct & Ecological Interventions

Issue a biennial open request for proposals (RFP) to support research projects focused on identifying alternative options for either direct treatments or indirect interventions for SCTLD. Research projects should explore alternatives to lesion-level treatments, including colony-level and reef-level treatment (e.g., probiotic application, antiviral application), methods of enhancing the success of current intervention techniques, and potential ecological interventions like the removal of coral predators or manipulation of coral cover. Due to environmental compliance requirements and because interventions affect the environment, an evaluation of the indirect and cumulative impacts for the intervention would be required as part of the proposed experimental design, in efficacy and effectiveness determinations, and in any permitting/reporting requirements.

Activity Lead

NOAA Coral Reef Conservation Program, NOAA National Centers for Coastal and Ocean Science

Potential Activity Partners

Research institutions; federal, state and jurisdictional governments; industry partners via Small Business Innovation Research or Cooperative Research and Development Agreement (manufacture of potential treatments)

Budget

Year 1: \$5,000,000

Year 3: \$5,000,000

Year 5: \$5,000,000

Total: \$15,000,000

Potential Funding Sources

Small Business Innovative Research, industry partners (e.g., Cooperative Research and Development Agreement (CREDA)), Congressional appropriations, federal & state agencies (e.g., NOAA, United States Geological Survey, Department of Interior, National Park Service)

Description of Efforts

Develop and issue RFPs in Years 1, 3, and 5 aimed at exploring alternative intervention options. Ensure RFP priorities reflect advancements in the development of new intervention techniques, the current status of reefs affected by SCTLD, and our understanding of disease etiology and pathology and factors controlling/enhancing resistance and resilience. Ensure that all proposals incorporate an element in the experimental design that will provide a semi-quantitative/quantitative analysis of the potential indirect and cumulative impacts of the proposed interventions being trialed.

Research projects should explore alternatives to lesion-level treatments, including colony-level and reef-level treatment (e.g., probiotic application, antiviral application), methods enhancing the success of current intervention techniques, and potential ecological interventions like the removal of coral predators, manipulation of coral cover, culling, the restoration of resilient genotypes of susceptible species and non-susceptible species, reintroduction of keystone species such as urchins, and improving habitat and water quality.

Timeline

Year 1: Issue RFP, conduct external review, undergo selection process

Year 3: Issue RFP, conduct external review, undergo selection process

Year 5: Issue RFP, conduct external review, undergo selection process

Ongoing: Communicate with researchers, track project progress, communicate outcomes as appropriate

Measurable Outcomes

1. Number of funded projects
2. Number of coral disease intervention methods tested
3. Number of corals treated and treatment effectiveness quantified
4. Number of reefs where disease has been mitigated or habitat improvements have been completed
5. Number of research/management partnerships

Objective 1e: Promote multi-sector projects and partnerships to study potential vectors/sources, such as ballast water, biofilms, and other sea systems with regard to transmission over small and great distances.

Activity 1: SCTLD Transmission Experiments

Support research to inform SCTLD impact avoidance strategies from ship-based (e.g., ballast water, biofilms) and other disease sources (e.g., dive equipment), as well as treatment approaches (e.g., approved Ballast Water Treatment Systems (BWTS), anti-fouling, dive gear disinfection) to assess longevity of SCTLD infection and transmission reduction and prevention strategies.

Activity Lead

NOAA Atlantic Oceanographic and Meteorological Laboratory Coral Program

Potential Activity Partners

Naval Research Laboratory, Louisiana State University (LSU), United States Environmental Protection Agency, United States Coast Guard

Budget

Given the scope of this proposed activity, tasks are broken into four experimental projects, each with an estimated budget of approximately \$80,000. If all projects are supported, the proposed activities can be conducted in sequence/parallel for a total of \$275,000.

Potential Funding Sources

Environmental Protection Agency, NOAA Coral Reef Conservation Program, NOAA 'Omics

Description of Efforts

A preliminary study in FY21 confirmed that 1) SCTLD pathogens can be transmitted via water without direct contact between diseased and healthy corals, 2) simulated ballast water can transmit SCTLD pathogens and may cause a concentration effect, and 3) that UVC radiation (i.e., BWTS) is only partially effective in reducing risk of disease transmission via water (Studivan et al. Preprint Version 1). Additional experimentation is warranted to determine risks of further disease spread and/or persistence through human-mediated sources and activities, including ship's ballast water, ship's biofilms, and dive gear; as well as to evaluate potential treatment/mitigation approaches to reduce transport risk. Accordingly, the following series of discrete experiments is proposed to address these research questions:

1. A follow-up study to evaluate the treatment/sterilization of ballast water using additional approaches (e.g., filtration, chemical sterilization).
2. An experiment to determine the potential for simulated ship biofilms to transmit SCTLD.
3. An experiment to evaluate the potential for wetsuits, dive equipment, and associated biofilms to transmit SCTLD.
4. A follow-up study to evaluate the treatment/sterilization of disease sources tested in Project 3.

These studies will each leverage existing high-replication disease transmission infrastructure at the [Experimental Reef Lab](#) at the Cooperative Institute for Marine and Atmospheric Studies (CIMAS), and build upon prior investigations involving simulated ballast water and downscaled ballast water treatment systems. A modular approach using Experimental Reef Lab infrastructure will allow rapid testing of additional disease sources/reservoirs and incorporation of in-line treatment approaches. Together, these experiments will more broadly characterize the potential for human activities to contribute to the spread of SCTLD pathogens, particularly across regions. The results of the experiments incorporating evaluation of treatment approaches will help provide actionable recommendations

to regulatory partners and managers to reduce risk of additional disease spread and mitigate impacts of the disease on new reefs and regions.

Timeline

Timelines for each project are similar, and would require eight months each to complete. If all projects are funded together, they can be completed within a period of two years.

Month 1: Permitting and preparation

Month 2: Sample collection, transportation, acclimation

Months 3-4: Transmission experiment

Months 5-6: Physiological, histological, and statistical analysis

Months 7-8: Manuscript preparation

Measurable Outcomes

1. Identification of SCTLD sources and reservoirs
2. Identification of risks associated with disease spread through commercial (ship transport) and recreational (diving) activities
3. Evaluation of practical mitigation and treatment techniques for ships and divers

Activity 2: Risk Profile for Vessels

Create a risk profile for vessels traveling from Florida/the Caribbean to the Pacific as a targeted approach to inform compliance and in-water monitoring. Vessels identified as higher risk could require compliance inspection to ensure they are meeting current ballast water discharge regulations.

Activity Lead

U.S. Coast Guard, Office of Commercial Vessel Compliance (CG-CVC), NOAA Coral Reef Conservation Program

Potential Activity Partners

Coast Guard Office of Environmental Standards (CG-OES)

Budget

No budget needed for this activity

Potential Funding Sources

Funding Sources: No budget needed for this activity, work can be performed by CG HQ offices CG Office of Environmental Standards (CG-OES) and Office of Commercial Vessel Compliance (CG-CVC)

Description of Efforts

Evaluate whether USCG can implement a targeted approach to evaluate compliance for vessels carrying water from Florida and/or the Caribbean to the Indo-Pacific region. Create risk profiles for vessels traveling from Florida and/or the Caribbean to the Pacific by categorizing vessels based on prior history. Vessels identified as higher risk could require compliance inspection to ensure they are meeting current regulations (i.e., exchange, use of treatment systems). Evaluate potential for long-distance transport from U.S. Atlantic-Caribbean to U.S. Pacific by analyzing the history of ship transfers/ballast uptake and discharges among regions. Evaluate need for increased compliance inspection based on vessel risk profile.

Timeline

60 days to generate a risk profile graphic

Measurable Outcomes

1. Risk profile graphic that shows risk level hierarchy for vessels potentially transporting SCTLD via ballast water.
2. Graphic that may be used by regulators, working group partners to inform compliance activities, and to educate the industry and public.

Activity 3: Identification of High-Risk Ports in the Pacific

Use a risk assessment for unaffected areas and ports as a predictive approach and to guide local in-water Pacific coral reef surveillance and monitoring efforts in high-risk ports.

Activity Lead

U.S. Coast Guard, Office of Commercial Vessel Compliance (CG-CVC), NOAA Coral Reef Conservation Program

Potential Activity Partners

Coast Guard Office of Environmental Standards (CG-OES), NOAA, Smithsonian Environmental Research Center

Budget

Use of existing funds

Potential Funding Sources

Existing National Ballast Information Clearing House Contract supervised by U.S. Coast Guard Office of Environmental Standards (CG-OES)

Description of Efforts

Engage with the National Ballast Information Clearing House to identify U.S. ports with the greatest risk profiles based on amounts of discharged ballast water, which will help guide in-water Pacific coral reef surveillance and monitoring. Expand on and analyze existing data from vessel transfers/ballast discharges coupled with survey data of disease prevalence. Coast Guard proposes to provide a list of high-risk ports in unaffected areas in the Pacific region considering vessel types, vessel traffic, and volume of ballast water transported.

Timeline

6 months

Measurable Outcomes

1. Snapshot of “risk” for U.S. ports with to-be-determined risk levels and associated categories, including a graphic display that can be utilized in briefing documents and for guiding policy development.
2. Increased targeting of vessels traveling to those ports with the intention of discharging ballast water.
3. Coral reef surveillance and monitoring programs in the Pacific guided by the identification of high-risk ports.

Activity 4: Research for Coastal Construction SCTLD Impact Avoidance and Integration of Findings into Mitigation Efforts

Support research to inform SCTLD impact avoidance strategies from coastal construction activities such as dredging, including these four priorities: (1) investigate how long sediments can remain infectious with SCTLD, (2) research the role sediments play as a disease reservoir versus a means of pathogen transport, (3) evaluate mitigation and transmission reduction methodologies using sediment sources as a model, and (4) understand the susceptibility of coral species, including those listed under the Endangered Species Act, to SCTLD infection from sediment movement.

Activity Lead

NOAA Atlantic Oceanographic and Meteorological Laboratory Coral Program

Potential Activity Partners

University of Miami Cooperative Institute for Marine and Atmospheric Studies, Louisiana State University (LSU)

Budget

Given the scope of this proposed activity, tasks are broken into four experimental projects, each with an estimated budget of approximately \$80,000. If all projects are supported, the proposed activities can be conducted in sequence/parallel for \$200,000 total.

Potential Funding Sources

NOAA 'Omics, NOAA Coral Reef Conservation Program, Environmental Protection Agency Office of Wetlands, Oceans, and Watersheds

Description of Efforts

A study conducted in FY21 confirmed that disease-exposed reef sediments were able to elicit signs of SCTLD in healthy corals, without direct contact between diseased and healthy corals (Studivan et al. Preprint Version 1). This study also identified SCTLD-associated microbes in inoculated sediments and hypothesized that sediments may be serving both as a disease source and reservoir. These potential relationships should be investigated with further lab-based experiments to determine 1) the persistence of SCTLD pathogens in sediments, 2) disease source versus reservoir potential, 3) effectiveness of treatment approaches, and 4) coral species susceptibility to disease-exposed sediments. These activities can be broken down into four discrete experiments:

Project 1. An experiment to assess SCTLD persistence in sediments using time-series incubations.

Project 2. A preliminary investigation to replicate sediment transport (i.e., resuspension) as a test of reservoir versus disease source potential of sediments.

Project 3. An experiment to evaluate the treatment/sterilization of disease-exposed sediments.

Project 4. An experiment with multiple coral species (with an emphasis on ESA-listed species) to determine susceptibility across taxa.

These studies will each leverage existing high-replication disease transmission infrastructure at the [Experimental Reef Lab](#) at the Cooperative Institute for Marine and Atmospheric Studies (CIMAS) and build upon prior investigation involving transmission sources (sediments, ballast water). Together, these projects will determine the role(s) that sediments may have played in the spread and persistence of the SCTLD outbreak, identify potential risk of sediment transport in contributing to continued persistence and/or local outbreaks, and evaluate potential mitigation strategies in reducing risk of SCTLD transport via sediments.

Timeline

Timelines for each project are similar and would require eight months each to complete. If all projects are funded together, they can be completed within a period of two years.

Month 1: Permitting and preparation

Month 2: Sample collection, transportation, acclimation

Months 3-4: Transmission experiment

Months 5-6: Physiological, histological, and statistical analysis

Months 7-8: Manuscript preparation

Measurable Outcomes

1. Identified potential risk(s) of SCTLD transmission from sediment among coral species
2. Identification of SCTLD transmission sources
3. Evaluation of disease source vs. reservoir potential of sediment
4. Evaluation of sediment treatments as a disease mitigation strategy

Objective 1g: Expand applications of ‘omics, artificial intelligence (AI), and uncrewed systems for surveillance (e.g., water quality, coral health across reef zones, including mesophotic reefs) and/or research (e.g., understanding coral resilience, SCTLD etiology/pathology).

Activity 1: Use Artificial Intelligence (AI) for SCTLD Detection

Advancing technologies in uncrewed platforms and image recognition algorithms has increased our ability to autonomously explore and characterize benthic habitats through photo quadrats and photogrammetry of large plots. Post-processing identification of coral taxonomy to the species level is also available. Most of these technologies are optimized for deeper environments, including mesophotic coral ecosystems found between 30-150m due to logistical challenges of deploying remotely operated vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs) at shallower depths. Continued development of these technologies should be directed toward increasing the ability to identify signs of stress on coral communities, including SCTLD. Specifically, research activities should give priority to improving artificial intelligence and/or cloud computing technologies in analysis and detection of disease from existing and new photo and video datasets.

Activity Lead

NOAA Center for Artificial Intelligence (NCAI)

Potential Activity Partners

NOAA labs, National Marine Sanctuary offices, academic institutions, Environmental Protection Agency, United States Geological Survey, Department of Defense, Non-Government Organizations

Budget

Research activities to implement and validate uncrewed platforms, image recognition algorithms, and structure from motion 3D models would generally require research expeditions with larger vessels, necessitating significant investments (>\$1 million) to support expeditions and post-processing (both in terms of hardware/software and personnel time). These efforts should leverage existing funding and research expeditions (e.g., RESTORE, OER), as well as support collaborations with partner institutions and local researchers (i.e., university research groups) that are already conducting habitat exploration/characterization expeditions and disease surveys.

Potential Funding Sources

NOAA Ocean Exploration and Research, NOAA ‘Omics, NOAA Cooperative Institutes, NOAA Coral Reef Conservation Program, Department of Interior, Environmental Protection Agency, United States Coast Guard, Department of Defense

Description of Efforts

Advancing technologies in uncrewed platforms and image recognition algorithms has increased our ability to autonomously explore and characterize benthic habitats through photo quadrats and photogrammetry of large plots, and with post-processing identification of coral taxonomy to the species level. Most of these technologies are optimized for deeper environments, including mesophotic coral ecosystems found between 30-150m due to logistical challenges associated with deployment of technology platforms (e.g., ROVs) at shallower depths.

To facilitate rapid implementation of activities and to maximize cost-sharing opportunities, these activities should be incorporated into existing research expeditions and disease survey efforts. For example, such efforts are already ongoing in the Flower Garden Banks National Marine Sanctuary, the Florida Keys National Marine Sanctuary, Puerto Rico, and the U.S. Virgin Islands to explore and characterize coral reef ecosystems, including to quantify impacts of SCTLD on coral populations. SCTLD survey efforts throughout Florida and the U.S. Caribbean have also been ongoing for several years and are often led by local university research groups (e.g., Florida Atlantic University-Harbor Branch Oceanographic Institute, Nova Southeastern, University of the Virgin Islands).

NOAA has the technical and platform expertise to organize and maintain consistent photo/video data collection throughout coral reef territories and should provide these resources to local survey partners for deployment. NOAA personnel can then maintain and curate datasets generated from these deployments to assess disease prevalence and community impacts. Implementation and completion of this activity is contingent on consistent approaches/instrumentation across a broad spatial range, which is a specialty of existing NOAA research programs such as the [National Coral Reef Monitoring Program](#) (NCRMP). NOAA can also dedicate resources to the development of artificial intelligence and/or cloud computing technologies to allow rapid recognition and quantification of disease impacts from reef survey data. These efforts should prioritize the development of novel approaches for surveillance and monitoring to improve detection and minimize processing time. Advancements should leverage programs using artificial intelligence (AI) processing of benthic photo quadrats (e.g. CoralNet) or photogrammetry to develop capacity to detect and assess SCTLD impacts from imagery.

Timeline

These activities should leverage ongoing efforts as much as possible to rapidly contribute to disease survey and reef exploration activities, as well as to reduce additional costs for use of resources to support uncrewed platforms and downstream data processing. These activities are also expected to persist beyond the SCTLD outbreak, as they will provide critical data and infrastructure to support assessments of coral reef health, particularly during stress/disturbance events (e.g., bleaching events, disease outbreaks, hurricanes). Progress and success should be evaluated for all activities on a yearly basis to allow for modification of SOPs or allocations of funding and resources.

Measurable Outcomes

1. Improve disease surveys and collect additional photo/video data through development of novel data collection/analytical pipelines.
2. Increased ability to recognize and characterize coral health in response to stress events, facilitating exploration and characterization of additional coral reef ecosystems beyond the current scope of monitoring and sampling efforts.

Activity 2: Evaluation of Coral Resilience and Resistance to SCTLD

Issue competitive requests for proposals (RFPs) to support research projects focused on identifying resilience and resistance among coral genotypes, coral populations, and specific reef locations, and the identification of biomarkers that can help screen for these traits. Research may also focus on the assessment of environmental indicators of reef health and the identification of ways to improve restoration success in the face of disease outbreaks. These research efforts should incorporate an examination of coral genotypes, algal symbionts, and microbial communities. Results will not only benefit efforts related to SCTLD but will enhance the ability to identify resilient coral genotypes across multiple stressors.

Activity Lead

NOAA Coral Reef Conservation Program

Potential Activity Partners

NOAA National Centers for Coastal Ocean Science, NOAA Atlantic and Oceanographic Meteorological Laboratory, United States Geological Survey, State of Florida, academic partners, non-governmental organizations

Budget

Year 1: \$15,000,000

Year 4: \$15,000,000

Total: \$30,000,000

Potential Funding Sources

NOAA, public/private partnerships

Description of Efforts

Develop and issue an RFP in Years 1 and 4 aimed at identifying coral resistance and resilience to SCTLD. Ensure the specifics of the RFPs reflect changes in the status of reefs affected by SCTLD, our understanding of disease etiology and pathology, and other advancements in disease research. These research efforts should incorporate an examination of coral genotypes, algal symbionts, and microbial communities. Results will not only benefit efforts related to SCTLD but will enhance the ability to identify resilient coral genotypes across multi-stressors.

Timeline

Year 1: Issue RFP, conduct external review, undergo selection process

Year 4: Issue RFP, conduct external review, undergo selection process

Ongoing: Communicate with researchers, track project progress, communicate outcomes as appropriate

Measurable Outcomes

1. Number of funded projects
2. Number of research/management partnerships
3. Maps showing the location of resilient sites (possibly overlaid with spatial data on environmental indicators of reef health)
4. Publications detailing characteristics of SCTLD-resistant individuals, populations, and/or sites
5. Databases of genetic, transcriptomic, proteomic, and/or metabolomic profiles for susceptible species

Activity 3: Identification of Causation and Diagnostic Development

Issue competitive requests for proposals (RFPs) to fund research to support: (1) the investigation of SCTLD causation and risk factors that affect disease dynamics, and (2) the development of diagnostics for determining SCTLD susceptibility and/or resistance of coral colonies and confirmatory tests of clinical and/or subclinical conditions specific for SCTLD. The use of transdisciplinary, multi-investigator studies of disease provides an integrated approach that more readily extends the understanding of disease dynamics. Priorities under this RFP will include projects with multi-investigator teams using common samples and integrated transdisciplinary approaches (e.g., histopathology, epidemiology, genomics, transcriptomics, proteomics, metabolomics, and culturomics) for differential diagnostics (e.g., identification of morphological and pathophysiological shifts among healthy and diseased individuals).

Activity Lead

NOAA National Centers for Coastal Ocean Science and Coral Disease and Health Consortium

Potential Activity Partners

National Center for Coastal Ocean Science, National Marine Fisheries Service, Office of National Marine Sanctuaries, Coral Reef Conservation Program, United States Geological Survey, Center for Disease Control, nongovernment organizations, universities, and industry

Budget

Year 1: \$10,000,000

Year 4: \$10,000,000

Total: \$20,000,000

Potential Funding Sources

Private-public partnerships, Small Business Innovative Research (SBIR), Small Business Technology Transfer (STTR), research institutions, state and jurisdictional governments

Description of Efforts

Develop and issue an RFP in Years 1 and 4 aimed at supporting the identification of causative agents and development of a diagnostic for SCTLD exposure and/or resistance. Ensure the specifics of the RFP reflect technological advancements and advancements in our understanding of disease resistance/resilience, etiology, and

pathology. The use of a multi-omics approach in studying disease has proven to complement and extend understanding of disease dynamics. Therefore, this RFP will prioritize projects utilizing a multi-omics approach (e.g., genomics, transcriptomics, proteomics, metabolomics, and culturomics) for identification of functional shifts among healthy and diseased individuals.

Timeline

Year 1: Issue RFP, conduct external review, undergo selection process

Year 4: Issue RFP, conduct external review, undergo selection process

Ongoing: Communicate with researchers, track project progress, communicate outcomes as appropriate

Measurable Outcomes

1. Number of funded projects
2. Number of SCTLD-related 'omics samples
3. Number of new inter-agency research partnerships

Objective 1h: Conduct laboratory transmission experiments with Pacific corals to identify susceptibility of Pacific coral species to SCTLD and incorporate results into SCTLD surveillance and preparedness planning.

Activity 1: Evaluating the Susceptibility of Pacific Corals

Determine if Pacific species are susceptible through *ex situ* experimentation, with an initial focus on *Pocillopora* and *Porites*, the primary reef-building genera in the eastern tropical Pacific. Share results and findings with local jurisdictional resource managers.

Activity Lead

NOAA Atlantic Oceanographic and Meteorological Laboratory Coral Programs

Potential Activity Partners

Smithsonian Tropical Research Institute (STRI), Louisiana State University (LSU)

Budget

Total: \$100,000

Potential Funding Sources

NOAA Coral Reef Conservation Program, Environmental Protection Agency Office of Wetlands, Oceans, and Watersheds

Description of Efforts

Given the widespread devastating effects of SCTLD throughout the Caribbean and the hypothesized transportation through ship ballast, there exists the very real possibility that the disease could be transported into the Pacific with profound implications for coral reef persistence. Given that ship traffic from the Caribbean to the Pacific is largely directed through the Panamá Canal, and that ships often hold on each side of the canal due to customs and logistical considerations, it is probable that if disease breakthrough is to occur, it will occur in the Gulf of Panamá (GOP). In this region, the primary reef-building species are *Pocillopora damicornis* and *Porites lobata*, which exist in patchy incipient reef formations near the canal (see Glynn and Mate 1997). To date, it is not known whether transmission of SCTLD to wild populations of these species is possible, though there have been some limited experiments assessing transmissibility to commercially-grown Indo-Pacific corals. Moreover, if it is possible, it is presently unknown how

disease signs will manifest. Since clear description of signs is the first step in identification, quarantine, and mitigation, it is imperative that this research be conducted in a timely manner.

In order to address this pressing research question, lab-based experiments can be conducted to 1) determine whether wild-collected Pacific coral species are susceptible to SCTLD, and 2) to determine how the disease manifests visually and histopathologically. We propose to conduct an initial experiment with the most common coral species from the GOP, *P. damicornis* and *P. lobata*. This activity will leverage an existing collaboration with STRI for local familiarity, permitting, collections, and infrastructure support, and will be conducted with collaborators at LSU to perform histological examination of disease-exposed coral tissues. A disease challenge experiment utilizing waterborne transmission will be conducted using existing high-replication disease transmission infrastructure at the [Experimental Reef Lab](#) at the Cooperative Institute for Marine and Atmospheric Studies (CIMAS). The ultimate goals of this activity are to (1) characterize the susceptibility of two sentinel species from the GOP, and (2) develop a case definition of disease signs at the colony and tissue levels to support further experimentation into species susceptibility and enhanced preventative monitoring and/or responses to potential outbreaks in the region. These actions are of utmost importance to prevent and potentially mitigate the spread of SCTLD to Pacific reefs.

Timeline

The proposed experiment would require ten months to complete given the travel and coral transport logistical considerations.

Months 1-2: Permitting and preparation

Months 3-4: Sample collection, transportation, acclimation

Month 5: Transmission experiment

Months 6-8: Physiological, histological, and statistical analysis

Months 9-10: Manuscript preparation

Measurable Outcomes

1. Evaluation of SCTLD susceptibility of two common reef-building species present on the Pacific side of the Panama Canal
2. First diagnostic and histological description of SCTLD in Pacific coral species, thereby aiding in early identification if an outbreak should occur

Activity 2: SCTLD Surveillance in Panama

Coordinate with the Smithsonian Tropical Research Institute in Panama to incorporate SCTLD surveillance into monitoring protocols in Panama's Pacific and Caribbean regions. The detection of SCTLD in Panama would indicate that the disease is spreading into the Pacific.

Activity Lead

NOAA Atlantic Oceanographic and Meteorological Laboratory Coral Programs

Potential Activity Partners

Smithsonian Tropical Research Institute (STRI)

Budget

Activities supported by other budgets (Objective 1h, Activity 1) and ongoing working groups (Florida SCTLD Response Caribbean Cooperation Team)

Potential Funding Sources

N/A

Description of Efforts

During field operations conducted for Objective 1h, Activity 1, project leads will coordinate with local scientists and resource managers affiliated with STRI to give a presentation on SCTLD. The NOAA SCTLD Coordinator will involve partners in Panama in the Caribbean Cooperation team that already seeks to inform Caribbean partners about SCTLD monitoring, research, and treatment efforts.

Timeline

The in-person activities would be done in conjunction with Objective 1h, Activity 1 focused on evaluating the susceptibility of Pacific corals. The Caribbean Coordination meetings are ongoing.

Measurable Outcomes

1. Improved collaborative relationships among Caribbean/Pacific partners
2. Increased capacity to respond to the threat of SCTLD spread across ocean basins
3. Local personnel in Panama trained in disease identification
4. Inclusion of local personnel in ongoing meetings to address the state of research and treatment efforts
5. Panamanian reefs being monitored for SCTLD

Goal 2: Build capacity for coral disease detection, prevention and intervention

Objective 2a: Coordinate exchange of information, personnel, and best practices between Atlantic and Indo-Pacific MPAs and other local jurisdictions.

Activity 1: Partnerships with Regional Networks

Identify relevant established regional networks and initiatives and reach out to develop specific partnership opportunities that will enable increased cooperation and coordination on SCTLD prevention, response, and preparedness and improved SCTLD information exchange.

Activity Lead

U.S. Coral Reef Task Force Coral Disease Working Group, Coral Disease Associate, NOAA Coral Reef Conservation Program

Potential Activity Partners

Leads of regional networks, organizations, and initiatives, including Pacific Islands Marine Protected Area Community, MPACConnect, Micronesia Challenge, the Global Coral Reef Monitoring Network and Atlantic and Gulf Rapid Reef Assessment

Budget

Total: \$3,000

Potential Funding Sources

NOAA Coral Reef Conservation Program

Description of Efforts

Identify goals for capacity-building for SCTLD prevention, response, and preparedness that may be accomplished via partnerships with regional networks and initiatives. Once goals are identified, identify a list of organizations, networks, and initiatives to contact that may help accomplish these goals. Reach out to these entities, setting up meetings to discuss SCTLD opportunities and provide organizations with relevant information relating to SCTLD. Once relationships have been established, identify specific opportunities to work with new partners to build capacity related to SCTLD and implement.

Timeline

1-3 Months: Identify goals, create a list of networks and initiatives and associated contacts, assemble/create introduction information packet for organizations, vet through U.S. Coral Reef Task Force Working Group

4-6 Months: Contact networks/initiatives, set up meetings to discuss opportunities, compile list of partnership opportunities and options for implementation

Measurable Outcomes

1. List of network coordinators who are now aware of SCTLD, and where to find resources and training materials
2. List of opportunities to build capacity for SCTLD response, preparedness, and prevention efforts
3. Increased capacity due to partnerships

Activity 2: SCTLD Preparedness in the U.S. Indo-Pacific

Support SCTLD preparedness in the U.S. Indo-Pacific by 1) fostering the development and ongoing coordination of a Pacific Coral Disease Network to facilitate communication, collaboration, training, and sharing of resources among Pacific jurisdictions, Freely Associated States, and marine protected areas in the U.S. Indo-Pacific; 2) retooling existing communications resources and materials (developed for the Caribbean by MPACConnect/Atlantic & Gulf Rapid Reef Assessment) for the Pacific; and 3) facilitating the development of an SCTLD response planning toolkit to assist coral

reef resource managers in unaffected U.S. jurisdictions as well as international locations in preparing for strategic responses to coral disease outbreaks.

Activity Lead

U.S. Coral Reef Task Force Coral Disease Working Group Pacific Preparedness Team; National Coral Disease Coordinator (Florida Sea Grant), NOAA Coral Reef Conservation Program, Coral Disease Associate (Florida Sea Grant)

Potential Activity Partners

Pacific Preparedness Team, Micronesia Challenge, Pacific Islands Marine Protected Areas Community, Atlantic and Gulf Rapid Reef Assessment, MPACConnect, Florida Disease Advisory Committee, jurisdictional natural resource management teams, NOAA Fisheries, National Marine Sanctuary sites, universities, nonprofits, SCTLD experts from affected jurisdictions

Budget

Pacific Coral Disease Network: \$25,000 total (\$5,000 per year)

Materials for Pacific Preparedness: \$28,000 total (\$15,000 to support graphic design and printing of materials as needed, \$8,000 for staff time, \$5,000 for translation)

Response Planning Toolkit: \$40,000 (for staff time to develop, editing and graphic design, and distribution activities (website, workshops, emails))

Year 1: \$5,000 (Pacific Coral Disease Network)

Year 2: \$5,000 (Pacific Coral Disease Network)

Year 3: \$5,000 (Pacific Coral Disease Network)

Year 4: \$5,000 (Pacific Coral Disease Network)

Year 5: \$5,000 (Pacific Coral Disease Network)

One-time costs: \$68,000 (materials for Pacific preparedness, response planning toolkit)

Total cost: \$93,000

Potential Funding Sources

NOAA Coral Reef Conservation Program, Department of Interior territorial grants

Description of Efforts

Pacific Coral Disease Network: Identify coral practitioners in Pacific jurisdictions, marine protected areas, and Freely Associated States interested in participating in the network. Work with network members to identify needs (training, resources, information-sharing, networking opportunities, etc.) and preferred methods of meeting needs (workshops, listserv, meetings, written updates, etc.). Consider the Florida Disease Response Caribbean Cooperation Team as a model. Develop and implement a strategy to meet needs of network members

Materials for Pacific Preparedness: To help build capacity for coral disease detection, prevention, and intervention in the U.S. Indo-Pacific, adapt existing SCTLD communications resources and materials for the Pacific. Existing SCTLD communications resources and materials developed for the Atlantic/Caribbean will be reviewed by the Pacific Preparedness Team, which will decide which materials are applicable to the Pacific. The team will then update and revise the content of those resources as needed. The resources will be translated into local languages if necessary and updated by a graphic designer. The resources will be reviewed by the broader Coral Disease Working Group and will then be distributed to target audiences virtually or via hard copy. The final resources will be housed on the Pacific Coral Disease Network online portal.

Response Planning Toolkit: Develop a response planning toolkit that incorporates materials developed by the U.S. Coral Reef Task Force Coral Disease Working Group Pacific Preparedness Team and the Florida Disease Response Caribbean Cooperation Team. The toolkit will include an overview of SCTLD, the need for preparedness planning,

and a guide for managers to follow to develop response plans for their jurisdiction. The toolkit will include an overview of response planning and modular sections to address key aspects of SCTL D response including: prevention plans, education and outreach (including citizen science), surveillance and monitoring, disease sampling, coral rescue, and intervention options. This toolkit will be connected with an online portal for accessing response information including training materials (documents, videos, and cheat sheets), worksheets for response planning, checklists for key activities, recommendations for response kits, guidance on permitting, suggestions for response drills, a collection of sample response plans, and a library of SCTL D literature. As the disease is rapidly spreading, this effort should target both U.S. and international jurisdictions to build collaboration and capacity. The toolkit should be updated at least annually to include emerging science and response strategies and serve as a living document to facilitate annual updates to jurisdictional response plans.

Timeline

Pacific Coral Disease Network:

Ongoing

Materials for Pacific Preparedness:

Months 1-3: Collate resources, identify resources most applicable to the Pacific

Months 4-8: Update resource content, review by Coral Disease Working Group

Months 9-12: Translate materials, update graphic design, print materials

Months 13-Onward: Distribute materials as needed

Response Planning Toolkit

Year 1: Develop toolkit materials and portal and initiate training

Year 2: Implement Pacific preparedness workshops and gather feedback from jurisdictions

Year 3: Evaluate and update as needed, conduct additional training

Measurable Outcomes

Pacific Coral Disease Network

1. List of network members
2. Identified needs of network members
3. Regular meetings, workshops, and communication exchange among network members
4. Increased communication and information sharing among Pacific jurisdictions regarding coral disease
5. Increased access to coral disease related resources and training for Pacific jurisdictions

Materials for Pacific Preparedness

1. SCTL D communications resources and materials modified for the Pacific
2. Distribution of materials to Pacific partners
3. Materials housed on online portal
4. Increased awareness among Pacific jurisdictions regarding SCTL D

Response Planning Toolkit

1. Development of response planning toolkit
2. Response planning toolkit available via online portal
3. Number of toolkit trainings conducted
4. Number of plans created or updated with new information, as needed

Activity 3: Interjurisdictional Collaborative Workshops

Support regular workshops to facilitate collaboration and information exchange amongst jurisdictions and regional partners. This activity would provide continued support for an annual U.S. Caribbean SCTL D Workshop to coordinate the exchange of information among affected areas to improve SCTL D responses. It would also support opportunities

to share lessons learned with unaffected Pacific jurisdictions to inform SCTLD response preparedness planning efforts.

Activity Lead

National Coral Disease Coordinator, NOAA Coral Reef Conservation Program

Potential Activity Partners

U.S. Coral Reef Task Force Coral Disease Working Group Pacific Preparedness and Affected Jurisdiction Teams, jurisdictional disease response coordinators, NOAA coral reef management liaisons

Budget

Year 1: \$75,000 (\$50,000 for U.S. Caribbean workshop and \$25,000 to support cross-regional learning exchanges)
 Year 2: \$75,000 (\$50,000 for U.S. Caribbean workshop and \$25,000 to support cross-regional learning exchanges)
 Year 3: \$75,000 (\$50,000 for U.S. Caribbean workshop and \$25,000 to support cross-regional learning exchanges)
 Year 4: \$75,000 (\$50,000 for U.S. Caribbean workshop and \$25,000 to support cross-regional learning exchanges)
 Year 5: \$75,000 (\$50,000 for U.S. Caribbean workshop and \$25,000 to support cross-regional learning exchanges)
 Total: \$375,000

Potential Funding Sources

NOAA Coral Reef Conservation Program

Description of Efforts

Host interjurisdictional collaborative workshops to help facilitate the exchange of information and best practices between and within affected and unaffected areas. Conduct an annual U.S. Regional Caribbean SCTLD Workshop, bringing together response teams from the U.S. Virgin Islands and Puerto Rico. Additional participants will include relevant SCTLD experts, colleagues from Florida, and potential learning exchanges with Pacific participants. This effort will also ensure that Atlantic and Caribbean partners participate in virtual and in-person Pacific preparedness workshops and as members of the Coral Disease Working Group Pacific Preparedness Team.

Timeline

Annual U.S. Regional Caribbean Cooperation workshop held annually. Collaboration between Atlantic, Caribbean, and Pacific colleagues is ongoing.

Measurable Outcomes

1. Number of workshops held
2. Workshop products developed, such as draft response/action plans, regional priorities, and communication materials
3. Number of Atlantic/Caribbean partners actively participating in Pacific preparedness workshops and on the Pacific Preparedness Team
4. Reported increase in knowledge of Pacific participants of 'lessons learned' from the Atlantic and Caribbean
5. Increased collaboration among affected jurisdictions on SCTLD response
6. Increased information exchange and coordination between the Atlantic, Caribbean, and Pacific
7. Enhanced Pacific preparedness plans that incorporate lessons learned from the Atlantic and Caribbean

Objective 2b: Support workshops and training sessions to increase capacity for communication, detection of and monitoring for SCTLD.

Activity 1: Pacific Preparedness Training and Workshops

Implement a series of workshops and trainings in unaffected Pacific jurisdictions, including field, classroom-based, and virtual trainings. These workshops and trainings will focus on SCTLD preparedness and increase capacity for communication, prevention, surveillance, response, rescue, and restoration by including information and lessons learned from the Atlantic/Caribbean region.

Activity Lead

U.S. Coral Reef Task Force Coral Disease Working Group Pacific Preparedness Team, National Coral Disease Coordinator, Coral Disease Associate, POCs from jurisdictional coral programs, NOAA Coral Reef Conservation Program

Potential Activity Partners

Hawai'i Sea Grant, Pacific National Marine Sanctuary Sites, citizen science programs (i.e. Eyes on the Reef in Hawai'i, Citizen Science Association), Pacific National Park Service staff, Pacific National Coral Reef Monitoring Program, Pacific Jurisdictional teams, Pacific marine protected area managers, Guam Sea Grant, NOAA Pacific Monuments staff, Pacific U.S. Fish & Wildlife Service staff, SCTLD partners from the Atlantic/Caribbean

Budget

Year 1: \$110,000 (\$30,000 for staff time, \$80,000 for jurisdiction-based training and workshops (\$20,000 per jurisdiction))

Year 2: \$110,000 (\$30,000 for staff time, \$80,000 for jurisdiction-based training and workshops (\$20,000 per jurisdiction))

Year 3: \$110,000 (\$30,000 for staff time, \$80,000 for jurisdiction-based training and workshops (\$20,000 per jurisdiction))

Total: \$330,000

Potential Funding Sources

NOAA Disaster Preparedness Program, NOAA Coral Reef Conservation Program

Description of Efforts

Work with agency and community partners in each of the four Pacific coral jurisdictions to assess jurisdiction-specific priorities and needs related to SCTLD preparedness and response planning. Based on the results of the assessment, organize a series of workshops and trainings to build capacity for preparedness and response in the Pacific jurisdictions. This may be a combination of virtual trainings, in-person workshops, and/or learning exchanges. Trainings will be prioritized based on jurisdictional needs and may include surveillance, prevention, monitoring, intervention, rescue, and communications. Initial efforts will be coordinated by the U.S. Coral Reef Task Force Coral Disease Working Group Pacific Preparedness Team and the National Coral Disease Coordinator and are expected to include virtual workshops/training sessions, field-based trainings, and classroom sessions to prepare for the potential spread of SCTLD to the Indo-Pacific. Partners from the Atlantic/Caribbean region will support these efforts. Initial workshops were held in 2021 and 2022. Training will help ensure the smooth implementation of rapid response plans, should an outbreak occur.

Timeline

Months 1-6: Conduct needs assessment

Ongoing: Conduct trainings and workshops as needed

Measurable Outcomes

1. Number of trainings and workshops conducted
2. Number of practitioners attending trainings and workshops
3. Number of materials developed and distributed to support training
4. Implementation of classroom-based refresher sessions as needed

Activity 2: Engaging Sea Grant Programs in SCTLD Response and Prevention

Engage individual Sea Grant programs in the implementation of jurisdictional SCTLD response and preparedness plans. Sea Grant programs have vast expertise in communications, outreach, education, citizen science, science interpretation, and more, and would be able to leverage this knowledge in SCTLD planning and response. By engaging individual Sea Grant programs to collaborate on the given needs of each jurisdiction, planning and response needs may be tailored to local areas.

Activity Lead

National Coral Disease Coordinator, NOAA Coral Reef Conservation Program

Potential Activity Partners

Hawaii Sea Grant, Florida Sea Grant, Guam Sea Grant, Texas Sea Grant, Puerto Rico Sea Grant, U.S. Coral Reef Task Force, Citizen science programs (i.e. Eyes on the Reef in Hawai'i, Citizen Science Association), Pacific and Atlantic jurisdictional teams, National Marine Sanctuary Education teams, National Park Service outreach teams, university partners

Budget

Year 1: \$100,000 for staff time and educational materials

Year 2: \$100,000 for staff time and educational materials

Total: \$200,000

Potential Funding Sources

NOAA Education, Sea Grant, NOAA Coral Reef Conservation Program, Department of Interior, National Fish and Wildlife Foundation

Description of Efforts

Engage with Sea Grant programs to ensure there is the capacity and ability to work on coral disease topics and assist with coral disease response and preparedness needs. Work with interested programs to identify areas for collaboration. Develop education and extension programs targeted at increasing coral disease awareness and engagement among community stakeholders, such as alert posters, coral disease awareness in school programs, and local web pages linking to coral disease information. Develop training materials for citizen science coral disease reporting programs including presentations, online training tools (video tutorials, online quizzes, photo gallery), and field guides. Develop graphic materials including posters, online and print ads, social media posts, and field guides for use in stakeholder outreach.

Timeline

Ongoing

Measurable Outcomes

1. Number of alert posters, infographic material, social media posts developed and/or shared
2. Preparedness plans shared and disseminated
3. Development of coral disease module for school presentations/activities
4. Coral disease information shared at public events
5. Coral disease information and links to important info (AGRRA) on local websites

6. Number of relevant education and extension programs established in Sea Grant programs
 7. Number of stakeholders engaged
-

Objective 2c: Support the development and/or updating of jurisdiction-specific response plans.

Activity 1: Annual Response Planning Workshops for Affected Jurisdictions

In affected jurisdictions (Florida, U.S. Virgin Islands, Puerto Rico), implement annual workshops to update jurisdiction-specific response plans and surveillance protocols.

Activity Lead

Jurisdictional SCTLD coordinators, NOAA Coral Reef Conservation Program

Potential Activity Partners

Jurisdictional coral disease response teams, National Coral Disease Coordinator, U.S. Coral Reef Task Force Coral Disease Working Group

Budget

Year 1: \$45,000 (\$15,000 per jurisdiction)
 Year 2: \$45,000 (\$15,000 per jurisdiction)
 Year 3: \$45,000 (\$15,000 per jurisdiction)
 Year 4: \$45,000 (\$15,000 per jurisdiction)
 Year 5: \$45,000 (\$15,000 per jurisdiction)
 Total: \$225,000

Potential Funding Sources

NOAA Coral Reef Conservation Program, state and territory cooperative agreements, Department of Interior, Coral Reef and Natural Resources grant program

Description of Efforts

Implement annual response planning workshops in jurisdictions affected by SCTLD to apply lessons learned and build upon or modify existing response plans and surveillance protocols. Workshops will be coordinated by each jurisdiction's respective coral disease coordinator in collaboration with relevant partners. Disease response plans and surveillance protocols will be updated as appropriate.

Timeline

Ongoing: One workshop held annually in each jurisdiction

Measurable Outcomes

1. Annual workshops in Florida, Puerto Rico, and the U.S. Virgin Islands
2. Annual updates to jurisdiction SCTLD response plans
3. Workshop products, such as draft response/action plans, regional priorities, and communication materials
4. Increased collaboration among affected jurisdictions on SCTLD response

Activity 2: Preparedness and Surveillance Planning – Unaffected Jurisdictions

In unaffected jurisdictions (Hawai'i, American Samoa, Guam, Commonwealth of the Northern Mariana Islands), facilitate the development of SCTLD response and preparedness plans and surveillance protocols. Update content in preparedness plans with new information if applicable.

Activity Lead

Pacific Coral Disease Coordinator (to be established), Coral Disease Associate, NOAA Coral Reef Conservation Program

Potential Activity Partners

Jurisdictional natural resource management teams, local entities involved in monitoring, National Park Service, National Marine Sanctuary and Monument sites, universities, nonprofits, U.S. Coral Reef Task Force Pacific Preparedness Team, SCTLD experts from affected jurisdictions, National Marine Monuments staff (NOAA & U.S. Fish & Wildlife Service)

Budget

Year 1: \$180,000 (\$100,000 for Pacific disease coordinator position, \$15,000 per jurisdiction to support workshops and in-person meetings and \$20,000 to support Coral Disease Associate)

Year 2: \$180,000 (\$100,000 for Pacific disease coordinator position, \$15,000 per jurisdiction to support workshops and in-person meetings and \$20,000 to support Coral Disease Associate)

Total: \$360,000

Potential Funding Sources

NOAA Coral Reef Conservation Program, state and territory cooperative agreements, Department of Interior Coral Reef and Natural Resources grant program

Description of Efforts

Work with partners in jurisdictions unaffected by SCTLD to establish SCTLD preparedness and response plans that identify research needs and institute prevention, education, preparedness, early warning, response, and intervention strategies. Where response or emergency plans already exist, update to include SCTLD. Depending on the needs of the jurisdictions, plans may include: 1) rapid reporting strategies through established communication plans to support coordinated response; 2) a description of coral disease survey methodologies and short- and long-term management measures; 3) an education and outreach plan to increase public awareness and support citizen science; 4) plans to coordinate with neighboring and potentially affected islands and jurisdictions; 5) identification of resources to support the implementation of the response plan (e.g., training documents, videos, and cheat sheets); 6) the development of a central portal for jurisdiction-specific disease information, data, and resources; 7) the identification of response kits; and 8) a description of drills and background level surveys during times of non-outbreak.

SCTLD subject matter experts will assist in plan development, providing necessary expertise and guidance.

Information and training materials outlined in plans will be updated as new SCTLD information becomes available.

Initial support for this activity is currently being provided by the U.S. Coral Reef Task Force Pacific Preparedness Team.

Timeline

Year 1: Plan and host workshops to support the development of response plans

Year 2: Develop and finalize response plans

Years 4-5: Update response plans based on local situation and new information

Measurable Outcomes

1. Number of meetings held to assist with plan development
2. Number of plans created within the Pacific Jurisdiction
3. Number of plans updated with new information, as needed

Objective 2e: Institute surveillance protocols to provide early warning and track disease progression

Activity 1: Monitoring and Surveillance for SCTLD in Affected and Unaffected Jurisdictions

Provide support for integrating SCTLD monitoring and surveillance into jurisdictional coral reef monitoring programs via trainings and workshops; provide resources for surveillance and monitoring activities; and integrate SCTLD monitoring and surveillance into National Coral Reef Monitoring Program (NCRMP) protocols.

Activity Lead

NOAA Coral Reef Management Liaisons, coral disease response teams in affected jurisdictions, natural resource management programs in unaffected jurisdictions

Potential Activity Partners

U.S. Coral Reef Task Force Coral Disease Working Group, nonprofits, National Coral Reef Monitoring Program Pls

Budget

Trainings and workshops: one-time cost of \$70,000 (\$10,000 per jurisdiction)

Monitoring: \$210,000 annually (\$30,000 per jurisdiction)

Integration in NCRMP protocols: one-time cost of \$60,000

Year 1: \$340,000 (\$30,000k for monitoring in each jurisdiction, \$70,000 for workshops, \$60,000 for NCRMP)

Year 2: \$210,000 (\$30,000k for monitoring in each jurisdiction)

Year 3: \$210,000 (\$30,000k for monitoring in each jurisdiction)

Year 4: \$210,000 (\$30,000k for monitoring in each jurisdiction)

Year 5: \$210,000 (\$30,000k for monitoring in each jurisdiction)

Total: \$1,180,000

Potential Funding Sources

NOAA Coral Reef Conservation Program, Office of National Marine Sanctuaries, National Marine Fisheries Service, Department of Interior, Department of Defense, Environmental Protection Agency, National Park Service, nonprofits

Description of Efforts

Develop and provide training on SCTLD surveillance and reporting to all local state/territory monitoring program participants with the goal of integrating SCTLD surveillance into local monitoring programs. Training and protocols will be developed in coordination with local jurisdictional teams.

Provide ongoing support for SCTLD monitoring and surveillance activities in both affected and unaffected jurisdictions to support activities included in response and preparedness plans. Funding may cover personnel, reporting and data management, or access to remote areas.

Integrate SCTLD surveillance into NCRMP monitoring protocols for Pacific jurisdictions. NCRMP personnel will be trained in disease identification to help inform tracking and response efforts. Because of the vast geographic coral reef area that is surveyed and the limited frequency and timing of surveys, NCRMP is not ideal for tracking the progression of SCTLD. However, NCRMP can help inform SCTLD monitoring efforts by informing background or baseline levels of all coral diseases in a given jurisdiction as a reference point for local monitoring efforts and providing “eyes-in-the-water” over a large stratified random sampling area. It can also provide data to local experts about sites with high coral density, coral cover, and the size of vulnerable coral species to inform local monitoring

efforts; provide subject matter expertise to help design a monitoring strategy to robustly survey for the disease; and provide contextual data about the impacts of mortality to coral populations by species where possible. The NCRMP design can be supplemented by local partners who use the same methods to monitor more frequently. This would allow data from partners and NCRMP to be comparable to assess disease status and trends.

Timeline

Year 1: Local jurisdictional monitoring program personnel, relevant NCRMP personnel, and NCRMP field partners are trained to recognize SCTL; establish reporting mechanisms

Year 2: SCTL surveillance training is incorporated as a standard part of local jurisdictional monitoring programs and where applicable, NCRMP training protocol

Ongoing: Support for monitoring and surveillance in affected and unaffected jurisdictions

Measurable Outcomes

1. Local monitoring programs trained to recognize possible SCTL in the field and report basic information in a timely manner
2. NCRMP personnel and partners trained to recognize possible SCTL in the field and report basic information in a timely manner
3. Reporting mechanisms established between NCRMP and local jurisdictional teams
4. SCTL surveillance training incorporated into local jurisdictional monitoring and NCRMP training protocols
5. Area of coral reefs monitored

Activity 2: Pacific Coral Disease Data Dashboard and Information Portal

Develop and maintain an online coral disease monitoring dashboard and information portal for the U.S. Indo-Pacific Region to provide a mechanism for the submission, review, and sharing of coral disease observations and data.

Activity Lead

U.S. Coral Reef Task Force Pacific Preparedness Team, NOAA Coral Reef Conservation Program

Potential Activity Partners

Pacific jurisdictions, NOAA Pacific Islands Fisheries Center, Micronesia Conservation Trust

Budget

Year 1: \$75,000 (establish dashboard and portal)

Year 2: \$20,000 (maintain and update dashboard and portal)

Year 3: \$20,000 (maintain and update dashboard and portal)

Year 4: \$20,000 (maintain and update dashboard and portal)

Year 5: \$20,000 (maintain and update dashboard and portal)

Total: \$155,000

Potential Funding Sources

NOAA Coral Reef Conservation Program

Description of Efforts

Develop a coral disease monitoring dashboard and information portal for the U.S. Indo-Pacific to organize coral disease data and informational resources in a central location. The portal will allow users to submit coral disease surveillance reports and upload coral disease information and data. The portal will also house informational resources related to coral disease, including training and educational materials. The resources that will be included will be determined via a needs assessment targeted at Pacific coral managers and practitioners.

The dashboard will provide a visual representation of the data and will serve to inform NOAA, partner agencies, and the research community as to the status of coral disease in the Pacific region. Identify a host for the site, considering the [Atlantic and Gulf Rapid Reef Assessment \(AGRRA\) Caribbean SCTLD dashboard as a model](#). Develop the dashboard and portal and collate informational resources to be added to the site. Launch the site and publicize it among partners. Conduct annual reviews of the site to ensure its utility and identify any gaps.

Timeline

Year 1: Conduct needs assessment, identify host

Year 2: Develop and launch portal

Year 3: Develop and launch dashboard

Ongoing: Occasional reviews to assess gaps and develop additional content

Measurable Outcomes

1. Portal launched
2. Dashboard launched
3. Number of informational resources housed on the portal site
4. Number of users accessing the dashboard and portal

Objective 2f: Scale NOAA capacity to respond to and treat affected coral in U.S. coral jurisdictions.

Activity 1: NOAA SCTLD Response Gap Analysis

Conduct a gap analysis to determine where NOAA human resource capacity for local response to SCTLD exists and where additional NOAA capacity is needed. Provide additional NOAA staff (federal and contract) time as needed to support gaps.

Activity Lead

NOAA Coral Reef Conservation Program

Potential Activity Partners

NOAA Line Offices and involved program offices (coordinated through the Coral Reef Conservation Program); coral reef management liaisons in Florida, Puerto Rico, and the U.S. Virgin Islands; other regionally based NOAA staff involved in SCTLD efforts.

Budget

Total: \$200,000

Potential Funding Sources

Incorporate into existing work plans, cooperative agreements (for filling gaps via support to local partners)

Description of Efforts

Use local and jurisdictional response documents and NOAA's SCTLD Strategy to determine current needs of SCTLD response. Within these needs, identify which needs are relevant for NOAA positions.

Inventory NOAA positions, evaluating existing NOAA positions (and percentage of time) that are invested in SCTLD response efforts in affected jurisdictions and regions, vulnerable jurisdictions and regions, and relevant offices. Identify NOAA positions with flexibility to increase their focus on SCTLD preparedness and response. Identify opportunities to introduce new positions (staff, contractors, fellows) that are needed.

Conduct a gap analysis, identifying and articulating where gaps exist between response priorities and NOAA human resource investments. Determine whether gaps can be filled with existing NOAA human resource capacity. Where gaps cannot be filled, articulate capacity building opportunities and/or areas where new positions can address gaps.

Timeline

Months 1-4: Inventory NOAA personnel and SCTL D needs

Months 5-9: Conduct gap analysis

Months 10-12: Develop plan to address gaps

Measurable Outcomes

1. Completed inventory of NOAA human resource investments
2. Collated SCTL D response needs
3. Completed gap analysis
4. Identified next steps to address gaps
5. New positions created to support SCTL D response efforts

Activity 2: Guidelines for Environmental Compliance Review of NOAA-Funded SCTL D Projects

Collaborate with other agencies via the U.S. Coral Reef Task Force Coral Disease Working Group to streamline permitting and environmental consultation processes for NOAA-funded coral disease related projects and initiatives. This could be done through programmatic options or clear step-by-step process guides for each jurisdiction.

Activity Lead

U.S. Coral Reef Task Force Coral Disease Working Group, NOAA Coral Reef Conservation Program

Potential Activity Partners

Environmental Protection Agency, National Marine Fisheries Service, Puerto Rico Department of Natural Environmental Resources, U.S. Virgin Islands Department of Planning and Natural Resources, Florida Department of Environmental Protection

Budget

This activity will be undertaken as part of programmatic activities of relevant staff in partner agencies.

Potential Funding Sources

N/A

Description of Efforts

Although each jurisdiction and project might have different permit requirements, all federally funded projects must undergo a step-by-step environmental consultation process to ensure compliance with federal legislation. However, this process is poorly understood within much of the coral disease response community and there is no specific guidance document to reference. Using the Coral Disease Working Group, the steps required to get a federally funded project through environmental consultation will be outlined for common SCTL D research, intervention, and rescue routines.

This will be useful not only for federally funded internally implemented projects but also for partner and award recipient projects using federal funds. Even though environmental consultation is conducted internally by the federal agency funding the project, it will be helpful for external applicants to be able to understand the process and know what will be required for the project to pass environmental review.

Timeline

Month 1: Coral Disease Working Group officially takes on this task and designates a lead

Month 2: Schedule relevant meetings with environmental consultation staff and review existing literature

Month 3: Develop draft guideline document, circulate draft to Coral Disease Working Group for review

Month 4: Finalize document, disseminate to U.S. Coral Reef Task Force agencies, and post on Task Force and NOAA Coral Reef Conservation Program websites

Measurable Outcomes

1. Development of guidelines for environmental compliance review
2. Number of federally funded coral disease-related projects with NEPA clearance
3. Decrease in the time it takes for federally funded projects to clear environmental consultation process

Activity 3: Treatment and Intervention in Affected Jurisdictions

Increase NOAA investment (funding and personnel) in treatment and intervention in affected jurisdictions.

Activity Lead

NOAA Restoration Center, NOAA coral reef management and fisheries liaisons

Potential Activity Partners

Jurisdictional SCTLD response teams, jurisdictional natural resource management agencies, Office of National Marine Sanctuaries, National Park Service, nonprofit and university partners, U.S. Coral Reef Task Force Coral Disease Working Group

Budget

Year 1: \$300,000 per year (\$100,000 per jurisdiction)

Year 2: \$300,000 per year (\$100,000 per jurisdiction)

Year 3: \$300,000 per year (\$100,000 per jurisdiction)

Year 4: \$300,000 per year (\$100,000 per jurisdiction)

Year 5: \$300,000 per year (\$100,000 per jurisdiction)

Total: \$1,500,000

Potential Funding Sources

NOAA Coral Reef Conservation Program

Description of Efforts

Increase NOAA investment in treatment and intervention activities in affected jurisdictions through funding and personnel. Specific intervention and treatment activities will be determined collaboratively with jurisdiction SCTLD response teams and will depend on the needs of the jurisdiction as well as their specific treatment and intervention approaches.

Timeline

Ongoing

Measurable Outcomes

1. Increase in number of corals treated
2. Decrease in SCTLD prevalence
3. Increase in number of personnel dedicated to treatment and intervention

Activity 4: NOAA Diver Decontamination Protocols

Ensure NOAA divers and NOAA-funded projects institute decontamination protocols to prevent SCTLD spread.

Activity Lead

NOAA Coral Reef Conservation Program

Potential Activity Partners

NOAA Diving Program, Florida Keys National Marine Sanctuary, NOAA National Centers for Coastal and Ocean Science

Budget

None

Potential Funding Sources

N/A

Description of Efforts

Establish a point of contact (POC) within the NOAA Diving Program training team or target head dive safety officer (DSO) if one does not already exist. Provide the POC with relevant information and materials on SCTLD, including a description of the disease, risks, and recommended decontamination protocols. The POC will then include decontamination protocols in future dive trainings with an emphasis on high-risk dive activities (e.g., divers traveling from the Atlantic/Caribbean region to the Pacific for field missions). A memo will be sent to all current NOAA divers detailing the risk of SCTLD transmission and associated decontamination protocols. Decontamination protocols will also be included in dive planning procedures and protocols.

Timeline

Months 1-6: Establish POC, provide SCTLD information to dive program, include decontamination in training programs, send out memo to all current divers

Ongoing: Include SCTLD in new diver training and dive planning

Measurable Outcomes

1. Number of NOAA divers who are using decontamination protocols
2. Number of NOAA dive plans that include decontamination protocols
3. Number of NOAA divers aware of risks of SCTLD spread through contaminated gear

Activity 5: National Coral Disease Coordination Capacity

Support a national coral disease coordinator, coral disease associate, and student intern to provide leadership and coordination to the U.S. national response to SCTLD across all currently affected and vulnerable jurisdictions. The positions will ensure effective coordination among federal agencies and facilitate communications, identify information and resource gaps, and efficiently allocate federal resources to ensure that the response is managed in a strategic, coherent and holistic manner. The positions will also provide coordination to the implementation of this plan, as well as track the progress of project activities and impacts.

Activity Lead

NOAA Coral Reef Conservation Program

Potential Activity Partners

Florida Sea Grant

Budget

Year 1: \$270,000
 Year 2: \$270,000
 Year 3: \$270,000
 Year 4: \$270,000
 Year 5: \$270,000
 Total: \$1,350,000

Potential Funding Sources

NOAA Coral Reef Conservation Program

Description of Efforts

Support a full-time national coral disease coordinator, full-time coral disease associate, and part-time student intern to ensure effective coordination of coral disease response, prevention, and preparedness efforts at the national level. These positions will track and report out on progress made on the SCTLD implementation plan, will coordinate multiple activities within this plan, and will co-chair the U.S. Coral Reef Task Force Coral Disease Working Group. The positions will also facilitate information sharing, serve as a liaison with other federal agencies in disease response efforts, coordinate with local coral disease response coordinators, identify and work to address information/research gaps, identify and engage new partners, update NOAA and Coral Reef Conservation Program leadership, provide training for resource managers and field researchers, and review and assist in the development of reports and recommendations. The student internship position will provide opportunities for students and young professionals to get direct experience with coral reef management and disease response.

Timeline

Ongoing

Measurable Outcomes

1. Oversight and tracking of the execution of the implementation plan
2. Identification of resources to support the implementation plan
3. Ongoing coordination of U.S. Coral Reef Task Force Coral Disease Working Group, including the facilitation of the Affected Jurisdictions, Pacific Preparedness, and Transmission Teams
4. Increased flow of information between local SCTLD response efforts and national efforts
5. Development of national disease response priorities
6. Identification of technical and financial resources to support jurisdictional response efforts
7. Coordination of workshops to support response and preparedness efforts
8. Development and maintenance of files on the capabilities and needs of each jurisdiction
9. Archived national level data on disease characteristics, spread, and treatment effectiveness
10. Engagement of new partners from government agencies, private institutions, and businesses
11. Development of reports and recommendations regarding coral disease response and preparedness efforts
12. Delivery of updates to federal and jurisdictional agency leadership as needed

Activity 6: Disease Response in Flower Garden Banks National Marine Sanctuary

Provide resources to support monitoring, intervention, and coral rescue in Flower Garden Banks National Marine Sanctuary.

Activity Lead

Flower Garden Banks National Marine Sanctuary

Potential Activity Partners

National Coral Reef Monitoring Program, NOAA Coral Reef Management Program, Florida Atlantic University Harbor Branch, University of North Carolina Wilmington, Rice University, Moody Gardens Aquarium, National Marine Sanctuary Foundation

Budget

Year 1: \$125,000 (\$50,000 for monitoring, \$50,000 for treatment and response, \$25,000K for coral rescue)
 Year 2: \$125,000 (\$50,000 for monitoring, \$50,000 for treatment and response, \$25,000K for coral rescue)
 Year 3: \$125,000 (\$50,000 for monitoring, \$50,000 for treatment and response, \$25,000K for coral rescue)
 Year 4: \$125,000 (\$50,000 for monitoring, \$50,000 for treatment and response, \$25,000K for coral rescue)
 Year 5: \$125,000 (\$50,000 for monitoring, \$50,000 for treatment and response, \$25,000K for coral rescue)
 Total: \$625,000

Potential Funding Sources

NOAA Coral Reef Conservation Program, National Marine Sanctuary Foundation, Office of National Marine Sanctuaries

Description of Efforts

Provide resources to support monitoring, intervention, and coral rescue in Flower Garden Banks National Marine Sanctuary, where, at the time of publication of this document, corals with SCTLD-like symptoms were recently detected. Specific monitoring, intervention, and treatment activities will be determined based on the characteristics of the disease along Sanctuary reefs. The activity will also include a planning process to develop a coral rescue plan and resources to implement that plan in partnership with Moody Gardens Aquarium and other facilities.

Timeline

Ongoing monitoring, intervention, and coral rescue within and around study sites in the Flower Garden Banks National Marine Sanctuary. Monitoring these sites falls in line with the Sanctuary's annual long-term monitoring program and will continue so long as the overall program continues. There will be ongoing intervention using field treatment methods as long as the SCTLD-like disease continues to be present in the Sanctuary.

Measurable outcomes

1. Increase in number of corals treated
2. Decrease in SCTLD prevalence
3. Area of coral reef monitored for SCTLD
4. Number of corals rescued for future restoration

Objective 2g: Support citizen science-based reporting systems to increase spatial awareness of SCTLD

Activity 1: Supporting Citizen Science in the Jurisdictions

Coordinate with individual states and territories to assess needs that relate to citizen science monitoring, using the information generated to produce jurisdiction-specific citizen science action plans that can be incorporated into overall response and preparedness plans. Implement activities in the action plans.

Activity Lead

Jurisdictional resource management agencies responsible for SCTLD response efforts, NOAA Coral Reef Conservation Program

Potential Activity Partners

Sea Grant programs (FL, PR, HI, GU, TX), National Coral Reef Monitoring Program, National Center for Coastal Ocean Science, NOAA Integrated Ocean Observing System, regional and local monitoring programs and networks, NOAA Office of Education

Budget

Year 1: \$35,000 for assessments (\$5,000 per jurisdiction)

Year 2: \$105,000 for implementation (\$15,000 per jurisdiction)

Year 3: \$105,000 for implementation (\$15,000 per jurisdiction)

Total: \$245,000

Potential Funding Sources

NOAA Office of Education, Sea Grant Programs

Description of Efforts

Each jurisdiction's needs for monitoring the spatial and temporal trends of SCTLD will guide the development of citizen science assessments in local priority sites. This effort will be coordinated and implemented with existing local monitoring networks and with newly trained citizen scientists. The main tasks under this activity are to (1) identify citizen science needs in each jurisdiction, (2) develop citizen science action plans to be incorporated in overall jurisdictional SCTLD response plans, and (3) implement activities identified in the action plans. Activities may include the identification of priority sites for citizen science monitoring, organizing trainings for new citizen scientists, developing tools for reporting and data storage, and/or highlighting citizen science-led programs using social media and outreach resources.

Timeline

Months 1-6: Conduct jurisdiction-specific citizen science needs assessments

Months 6-8: Develop citizen science action plans

Months 8-Onward: Implement activities as needed

Measurable Outcomes

1. Jurisdictional citizen science needs assessments
2. Jurisdictional citizen science action plans
3. Increase in citizen science reporting
4. Increase in number of trained citizen scientists

Goal 3: Support coral rescue, propagation, and restoration operations, research and partnerships across the U.S. to preserve the genetic diversity of corals necessary for future restoration efforts and support reef health.

Objective 3e: Establish a U.S. Caribbean coral rescue effort.

Activity 1: Coral Rescue Coordinator

Due to the scale and complexity of proposed U.S. Caribbean coral rescue efforts, a central coordinator is required. This coordinator will lead efforts to plan and execute coral rescue activities in the U.S. Virgin Islands and Puerto Rico, drawing on lessons from Florida coral rescue efforts and other genetic rescue, captive breeding, and species recovery efforts.

Activity Lead

NOAA Restoration Center, NOAA Coral Reef Conservation Program, NOAA Protected Resources Division, USVI Department of Planning and Natural Resources, Puerto Rico Department of Natural and Environmental Resources

Potential Activity Partners

National Park Service, Association of Zoos & Aquariums

Budget

Year 1: \$180,000

Year 2: \$180,000

Year 3: \$180,000

Year 4: \$180,000

Year 5: \$180,000

Total: \$900,000

Potential Funding Sources

NOAA, Department of the Interior

Description of Efforts

Hire a coordinator to lead efforts to plan and execute coral rescue activities in the USVI and Puerto Rico. Specific responsibilities include, but are not limited to, (1) assisting in the planning and executing of a U.S. Caribbean Coral Rescue Workshop; (2) supporting jurisdiction-specific coral rescue planning efforts; (3) supporting jurisdictions in the implementation of their coral rescue plans; (4) facilitating engagement with Florida coral rescue partners for information exchange; and (5) identifying financing mechanisms to support one-time and ongoing costs associated with coral rescue operations, holding, and care. The initial focus of this position will be to plan and execute a workshop with relevant partners to guide coral rescue efforts in the USVI and Puerto Rico.

The Coordinator will also work to establish an advisory group(s) to provide oversight and recommendations related to various aspects of coral care and husbandry. A model that may be considered is the Florida Reef Tract Rescue Project that includes several working groups (e.g., Coral Health Management Advisory Group, Coral Holding and Propagation Working Group, Messaging Advisory Group, and more). The Coordinator and the advisory group(s) will work to establish common norms, practices, procedures, and expectations of participating facilities.

Timeline

Months 1-3: Develop scope of work and advertise position

Months 4-5: Complete selection process and make offer

Month 6: Hire and onboard Coral Rescue Coordinator

Ongoing: Coral Rescue Coordinator completes activities in scope of work as detailed above

Measurable Outcomes

1. Scope of work developed
2. Interviews held
3. Offer(s) made
4. Position hired
5. U.S. Coral Rescue Workshop planned and executed
6. Implementation of activities outlined in scope of work
7. Policies, procedures, norms, etc. developed and/or updated

Activity 2: U.S. Caribbean Coral Rescue Workshop

Convene a workshop to plan a U.S. Caribbean coral rescue effort, including discussions on leadership and coordination of the effort, partner roles and responsibilities, and capacity of existing coral nurseries and/or aquaria. Workshop participants will consider alternate strategies for coral rescue operations, including whether a new, multi-jurisdictional facility is feasible and developing an assisted reproduction project by collecting gametes of highly susceptible species.

Activity Lead

National Coral Rescue Coordinator, NOAA coral reef and fisheries management Liaisons in the U.S. Virgin Islands and Puerto Rico

Potential Activity Partners

NOAA Restoration Center, The Nature Conservancy, Association of Zoos and Aquariums, Jurisdictional coral programs, Coral World

Budget

Total: \$80,000

Potential Funding Sources

NOAA Coral Reef Conservation Program (nonprofit cooperative agreement, domestic capacity building, internal funding, National Fish and Wildlife Foundation), NOAA Office of Coastal Management, National Marine Fisheries Service, nonprofit partners

Description of Efforts

Coral rescue in the U.S. Caribbean currently entails removing individual coral colonies or fragments from reefs (regardless of disease presence), rehabilitating them if needed, and storing them in land-based facilities. This project would convene a workshop focused on coral rescue in the U.S. Caribbean with the goal of developing a U.S. Caribbean Coral Rescue Plan that outlines specific, implementable actions and associated budgets needed for a Caribbean Coral Rescue Program. The workshop will include discussions on leadership and coordination, partner roles and responsibilities, collection targets (i.e. number of corals by species or jurisdiction), potential co-mingling of corals from different jurisdictions, potential integration of non-U.S. corals, and existing capacity of coral nurseries and/or aquaria. The Coral Rescue Plan will identify needed capacity for expansion, including the number of structures, types of structures, and the number and sizes of corals that can be hosted. Where facilities do not currently exist, the plan will identify alternate strategies for coral rescue operations.

Timeline

Year 1: Plan workshop

Year 2: Conduct workshop, finalize Coral Rescue Plan

Measurable Outcomes

1. Number of workshop attendees
2. Production and distribution of U.S. Caribbean Coral Rescue Plan
3. Portions of the Plan that are funded and implemented

Activity 3: Establishment of Land-Based Coral Nurseries

Work with partner organizations to establish and maintain new land-based coral nurseries in the U.S. Caribbean that can house rescued corals and support future restoration efforts for coral reefs that have been impacted by SCTLD.

Activity Lead

National Coral Rescue Coordinator, NOAA Restoration Center

Potential Activity Partners

Coral Restoration Consortium land-based propagation working group, National Marine Fisheries Service Protected Resources Division, jurisdictional regulatory authorities, Association of Zoos and Aquariums (AZA), AZA-accredited institutions, non-AZA coral holding institutions (as appropriate), Coral World, The Nature Conservancy

Budget

\$9,400,000 for each of three facilities. This includes \$8,860,000 in construction and land costs and \$540,000 for one year of annual operating costs and staffing for each facility.

Total: \$28,200,000

Potential Funding Sources

National Park Service, National Fish and Wildlife Foundation, NOAA Coral Reef Conservation Program, NOAA Fisheries, Association of Zoos and Aquariums, targeted fundraising via philanthropic organizations, private businesses, and the marine industry

Description of Efforts

Based on the goals of the rescue program, determine coral holding space requirements. Conduct outreach to facilities with coral husbandry experience to determine interest in joining a rescue program and inventory existing capacity, space + capacity, and space that can be made available. Identify additional capacity/space required to meet rescue goals.

Prioritize activities needed to place corals in holding. Place corals in facilities with existing capacity/space. Work with facilities to prepare capacity/space that can be made available and expand their space. Establish new facilities as needed.

Secure funds needed for one-time investments (e.g., construction, tanks, life support systems, etc.) and for ongoing costs (e.g., training, staff, operations).

Determine next steps. For example, will jurisdictions establish dedicated propagation programs? This will require new expertise, equipment, facilities, etc.

Establish necessary facility requirements and expectations. Determine coral monitoring requirements, data management approach, and steps to take if a facility does not fulfill their responsibilities.

Timeline

Year 1: Determine holding requirements based on outcomes of the U.S. Caribbean Coral Rescue Workshop; identify existing capacity to hold corals; begin preparing these systems to accept corals; identify and articulate needs for new coral holding space/capacity/husbandry; define facility requirements, expectations, monitoring needs, data management, and other related factors; begin rescue collections, place corals in prepared systems

Year 2: Continue rescue collections, guided by genetic management plans (e.g., based off Florida's coral genetic management plans) and available capacity, begin establishing and preparing new holding facilities

Year 3: Continue establishing and preparing new holding facilities, complete rescue collections, draft propagation plan(s), as appropriate

Year 4: Implement propagation plans

Ongoing: Fundraising, facility & new partner recruitment

Measurable Outcomes

1. Number of operational coral rescue facilities
2. Number of corals held in rescue facilities
3. Number of corals from each jurisdiction
4. Development of propagation plan(s), as appropriate
5. Number of coral aquarists trained and hired
6. Funding dedicated to rescue facility establishment & maintenance
7. Number of facilities brought into the program

Activity 4: Technical Assistance for Rescue, Propagation, and Restoration

Provide technical assistance in planning and/or executing coral rescue, propagation, and restoration activities. This may include the development of regional best management practices, as warranted and appropriate.

Activity Lead

NOAA Restoration Center

Potential Activity Partners

NOAA Coral Reef Conservation Program, Federal Emergency Management Agency, Puerto Rico Department of Natural and Environmental Resources, USVI Department of Planning and Natural Resources, Florida Department of Environmental Protection, Coral Restoration Consortium, National Park Service, jurisdiction SCTLD Response Teams (e.g., Coral Rescue & Propagation teams, Restoration teams)

Budget

Year 1: \$200,000 (Phase 1)

Year 2: \$100,000 (Phase 2)

Year 3: \$2,000,000 (Phase 3)

Year 4: \$5,000,000 (Phase 4)

Total: \$7,300,000

Potential Funding Sources

Federal Emergency Management Agency, NOAA Coral Reef Conservation Program, National Fish and Wildlife Foundation, U.S. Geological Survey, Department of Interior

Description of Efforts

This activity will support jurisdictions in the development of rescue, propagation, and/or restoration plans as requested; provide technical assistance in the implementation of these plans; and develop general guidance and best management practices for relevant activities. Priority will be given to Atlantic and Caribbean jurisdictions affected by SCTLD outbreaks. This activity is organized according to the 'pipeline' of rescue -> propagation -> restoration; as such,

the initial focus will be technical assistance and guidance related to coral rescue. This activity should occur following (and be informed by) the U.S. Caribbean Coral Rescue Workshop. To note, these planning processes should not pose a burden to jurisdictions with limited resources for priority emergency response.

Phase 1: This activity will begin with information sharing related to rescue operations that were not included in the workshop, followed by an assessment of needs in each jurisdiction related to planning and/or executing rescue operations. Based on these needs assessments, the activity lead(s) will support targeted technical assistance to the jurisdictions from experts. Ultimately, each jurisdiction should complete a rescue plan that can be used to solicit support and guide activities. These plans should include quantifiable, measurable targets (e.g., species/genotypes in holding, holding facilities established, etc.).

Phase 2: Following the creation of rescue plans and initial steps towards implementation, this activity will shift focus to technical support and guidance related to propagation and restoration. While the ‘pipeline’ includes subsequent steps for propagation → restoration, restoration goals may be the foundation for propagation targets and planning. As such, technical assistance for planning related to propagation and restoration should occur simultaneously. The activity lead should support the individual jurisdictions in articulating short- and long-term goals for propagation and restoration, as well as the technical needs to support achieving these goals. These goals and needs should be collated into jurisdiction-specific propagation and restoration plans (either as new, standalone plans or as updates to existing plans). These plans should include quantifiable, measurable targets (e.g., species under propagation, facilities engaged in propagation/restoration, sites/habitats receiving outplants). These targets should not be tied to outplant survival, as many SCTL-affected species are novel for use in restoration.

Phase 3: Following the development of propagation and restoration plans, technical assistance should focus on the implementation of the propagation components of the plans. This may include developing and/or sharing guidance and best management practices (e.g., adapted from Florida Reef Tract Rescue Project materials), sharing of relevant technology and specifications, collating funding opportunities, and other assistance as needs arise. To note, full implementation of the propagation plan(s) will likely extend beyond the initial five years of this plan.

Phase 4: As a final step, this activity should support the implementation of the restoration components of the aforementioned plans. This may include developing and/or sharing guidance and best management practices (e.g., adapted from Coral Restoration Consortium materials or jurisdiction-specific plans), sharing of relevant technology and outplant approaches, and other assistance as needs arise. Likely, outplanting and other restoration activities will be ongoing in jurisdictions throughout this activity period. To note, full implementation of the restoration plan(s) will likely extend beyond the initial five years of this plan.

Timeline

Year 1: Phase 1, following the U.S. Caribbean Coral Rescue Workshop

Year 2: Phase 2

Year 3: Phase 3

Year 4: Phase 4

Measurable Outcomes

1. Completed rescue, propagation, and/or restoration plan(s) for each jurisdiction
2. The meeting of quantifiable, measurable targets articulated in rescue plans (e.g., species/genotypes in holding, holding facilities established)
3. The meeting of quantifiable, measurable targets articulated in propagation and/or restoration plans (e.g., species under propagation, facilities engaged in propagation/restoration, sites/habitats receiving outplants)
4. Funding opportunities collated, shared, and/or pursued to support rescue, propagation, and/or restoration plan implementation
5. Guidance and/or best management practices collated for rescue, propagation, and restoration

Activity 5: Coral Rescue and Restoration Database

Develop a standardized comprehensive coral rescue and restoration database that tracks individual genotypes through the entire process of rescue, rehabilitation, husbandry, fragmentation, and outplanting.

Activity Lead

Coral Rescue Coordinator, NOAA Coral Reef Conservation Program

Potential Activity Partners

Coral Restoration Consortium, USVI Rescue Sub-team lead, coral rescue representatives from Florida and Puerto Rico

Budget

Year 1: \$150,000

Year 2: \$30,000

Year 3: \$30,000

Year 4: \$30,000

Year 5: \$30,000

Total: \$270,000

Potential Funding Sources

NOAA grants

Description of Efforts

Using the existing internal coral restoration and outplanting database created and utilized by the Coral Restoration Consortium (CRC), adapt and update the database and protocol to include rescued corals and increase accessibility to more partners. This may mean adding important front-end collection categories (disease state) and treatment information (any treatment received on intake or while in quarantine) that are currently not recorded on a typical coral restoration collection of a wild colony. Ensure all coral rescue practitioners are collecting relevant data by providing them with standardized site-specific datasheets and instruction and training on how to input their facility's data into the regional database on a regular basis.

Timeline

Months 0-3: Review CRC's database and highlight any missing data that might need to be added to incorporate coral rescue.

Months 3-6: Work with local rescue practitioners to develop facility/site-specific data collection protocols. Update CRC database with any necessary adjustments.

Months 6-9: Provide training to all rescue practitioners and jurisdictional managers on how to input and export data into regional CRC database.

Months 9-12: Follow up with rescue practitioners to ensure data is being entered. Troubleshoot any problems or issues they are having.

Month 12: Develop infographic using all data that has been inputted to demonstrate utility of the project.

Measurable Outcomes

1. Number of trainings conducted on standardized data collection and entry
2. Number of rescue and restoration facilities that are all gathering the same data and inputting data into the regional database
3. Number of coral genotypes tracked in database
4. Number of outplants from rescued corals tracked in database

Goal 4: Promote awareness of SCTLD science, status, and indicators.

Objective 4a: Partner with regional networks, initiatives, reef managers, and community leaders to develop and distribute resources to increase awareness and understanding of SCTLD.

Activity 1: National SCTLD Communications Strategy

Develop a national-level communications strategy and associated resources including messaging, social marketing, newsletters, and materials to target stakeholder groups.

Activity Lead

National Coral Disease Coordinator, U.S. Coral Reef Task Force Coral Disease Working Group, NOAA Coral Reef Conservation Program

Potential Activity Partners

Local jurisdictional agencies, Sea Grant, nonprofits, jurisdictional disease response teams, U.S. Coral Reef Task Force Communications Working Group

Budget

Total: \$30,000 to cover staff time, graphic designers, media advertising, press releases, and other relevant materials

Potential Funding Sources

NOAA Coral Reef Conservation Program state and territorial cooperative agreement, domestic capacity-building partnership cooperative agreement

Description of Efforts

Develop a communication strategy at a national level that includes key messages to reach targeted stakeholder groups. This will include targeting key audiences through social media, newsletters, and direct distribution of outreach and education materials (email lists, posters, infographics for jurisdictions, etc). The purpose of this plan is to ensure consistency of messaging on SCTLD at the national level and ensure there is a strategy to guide outreach and communications.

Timeline

Months 1-6: Develop national communications strategy

Months 7-Onward: Develop materials and implement strategy

Measurable Outcomes

1. National SCTLD communications strategy
2. Number of materials developed
3. Number of people reached by the strategy

Activity 2: Jurisdiction Communications and Outreach Plans

Develop, update, and implement jurisdiction-specific communications and outreach plans in jurisdictions affected by SCTLD.

Activity Lead

Jurisdiction coral disease response coordinators, NOAA Coral Reef Conservation Program

Potential Activity Partners

Jurisdictional agencies, jurisdiction disease response efforts, local Sea Grant programs, U.S. Coral Reef Task Force Affected Jurisdictions Team, National Coral Disease Coordinator, nonprofits

Budget

Year 1: \$30,000 (\$10,000 per jurisdiction)

Year 2: \$30,000 (\$10,000 per jurisdiction)

Year 3: \$30,000 (\$10,000 per jurisdiction)

Year 4: \$30,000 (\$10,000 per jurisdiction)

Year 5: \$30,000 (\$10,000 per jurisdiction)

Total: \$150,000

Potential Funding Sources

NOAA Coral Reef Conservation Program State and Territorial Cooperative Agreements, Domestic Capacity-Building Partnership Cooperative Agreement

Description of Efforts

Develop and/or update jurisdiction specific SCTLD communications and outreach plans that are relevant and specific to each jurisdiction's needs. Plans should include strategies such as social media, newsletters, messaging, and educational materials, as well as a detailed implementation plan, so messaging is clear and consistent across jurisdictions.

Timeline

Ongoing

Measurable Outcomes

1. Number of communications plans developed
2. Number of materials developed
3. Number of people receiving materials

Activity 3: SCTLD Newsletter and Monthly Updates

Regularly share relevant updates, resources, trainings, and research among a broad SCTLD community via a semi-annual newsletter and monthly digital updates. Ensure all updates and resources are readily available online.

Activity Lead

National Coral Disease Coordinator, Florida Sea Grant Coral Disease Associate, NOAA Coral Reef Conservation Program

Potential Activity Partners

Jurisdictional SCTLD response teams, SCTLD Caribbean Cooperation Team, U.S. Coral Reef Task Force Coral Disease Working Group, Atlantic and Gulf Rapid Reef Assessment

Budget

Year 1: \$8,000 (\$4,000 for design and \$4,000 for Coral Disease Associate)

Year 2: \$8,000 (\$4,000 for design and \$4,000 for Coral Disease Associate)

Year 3: \$8,000 (\$4,000 for design and \$4,000 for Coral Disease Associate)

Year 4: \$8,000 (\$4,000 for design and \$4,000 for Coral Disease Associate)

Year 5: \$8,000 (\$4,000 for design and \$4,000 for Coral Disease Associate)

Total: \$40,000

Potential Funding Sources

NOAA Coral Reef Conservation Program

Description of Efforts

Regularly share relevant SCTLD updates with key project partners and stakeholders via the preparation and distribution of monthly email updates and semiannual newsletters. The monthly email updates will include relevant research publications, grant opportunities, presentations/webinars, resources, and SCTLD national coordination programmatic updates. The monthly update will be shared with an email distribution list of partners and stakeholders and other relevant networks.

The semiannual newsletter will provide a high-level overview of important SCTLD milestones and updates in research and response to better engage external partners and agency leadership. Articles will include updates and relevant stories from affected and unaffected U.S. coral jurisdictions, the international Caribbean, and U.S. Coral Reef Task Force Coral Disease Working Group. The newsletter will be shared via email distribution, partner networks, listservs, and social media outlets where appropriate. All updates and newsletters will be available to the public through an online platform.

Timeline

Ongoing: Semi-annual newsletters will be issued twice a year and email updates will be distributed monthly

Measurable Outcomes

1. Number of newsletters published
2. Number of email updates shared
3. Number of individuals receiving updates and newsletters
4. Number of resources made available online

Activity 4: Annual SCTLD Report

Produce an annual report focused on SCTLD in U.S. waters, including the status of the disease, overview of jurisdictional response efforts, and national and regional coordination actions and accomplishments.

Activity Lead

National Coral Disease Coordinator, Florida Sea Grant Coral Disease Associate, NOAA Coral Reef Conservation Program

Potential Activity Partners

Jurisdictional disease response coordinators and response teams, jurisdictional agencies, U.S. Coral Reef Task Force Coral Disease Working Group, nonprofits

Budget

Year 1: \$3,000
 Year 2: \$3,000
 Year 3: \$3,000
 Year 4: \$3,000
 Year 5: \$3,000
 Total: \$15,000

Potential Funding Sources

NOAA Coral Reef Conservation Program

Description of Efforts

Produce an annual report focused on SCTLD in U.S. waters, including the status of the disease, overview of jurisdictional response efforts, and key accomplishments in terms of enhancing coordination of disease response, preparedness, and prevention at the national level. This report should be targeted at a broad audience outside of

the response and research community to inform and engage managers, decision makers, and the general public. The report should highlight challenges and next steps that might need action or support from decision makers.

Timeline

Ongoing

Measurable Outcomes

1. Number of reports developed
 2. Number of downloads/views from website
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Objective 4b: Work with other federal agencies on the U.S. Coral Reef Task Force to ensure SCTLD awareness and to facilitate its consideration in federal decision-making.

Activity 1: U.S. Coral Reef Task Force Coral Disease Working Group

Use the U.S. Coral Reef Task Force Coral Disease Working Group to facilitate effective collaboration and communication on coral disease status and response efforts among federal agencies, U.S. States and Territories, and Freely Associated States; build capacity for coral disease prevention, preparedness, and response; and prevent the further transmission of SCTLD.

Activity Lead

National Coral Disease Coordinator, NOAA Coral Reef Conservation Program

Potential Activity Partners

Coral Disease Working Group, U.S. Coral Reef Task Force Steering Committee

Budget

Year 1: \$50,000
 Year 2: \$50,000
 Year 3: \$50,000
 Year 4: \$50,000
 Year 5: \$50,000
 Total: \$250,000

Potential Funding Sources

NOAA Coral Reef Conservation Program, other U.S. Coral Reef Task Force agencies as appropriate

Description of Efforts

Through this activity, the U.S. Coral Reef Task Force (USCRTF) Coral Disease Working Group will advance collaborative efforts to ensure agencies (both federal and jurisdictional) are aware of the threats posed by SCTLD and to ensure that the disease is incorporated into decision-making processes. Specifically, regular SCTLD updates will be provided to agency leadership at the business meetings of USCRTF meetings. Actions will be identified that can be taken by the Steering Committee to support disease response and prevention. The roles of USCRTF agencies as they relate to SCTLD will be clearly articulated and relevant USCRTF resolutions will be developed. National SCTLD priorities will be identified and clearly communicated to agency leadership to motivate action. The Working Group will work to address these priorities via the efforts of the following sub-teams: 1) USCRTF Communications and Collaboration Team; 2) National Priorities Team; 3) Affected Jurisdiction Team; 4) Pacific Preparedness Team; and 5) Transmission Team.

Timeline

Ongoing

Measurable Outcomes

1. SCTLD updates at U.S. Coral Reef Task Force Business meetings
2. Development of national SCTLD priorities
3. U.S. Coral Reef Task Force resolutions on SCTLD
4. Increased action by federal and jurisdictional agencies focused on SCTLD
5. Accomplishment of Working Group initiatives led by Working Group sub-teams
6. Enhanced coordination of the U.S. national response to SCTLD
7. Increased coordination and communication among affected and unaffected jurisdictions
8. Enhanced awareness among agency leadership of the threat posed by SCTLD and actions that can be taken to mitigate

Goal 5: Collaborate with the coral reef management community to reduce stressors to coral reefs and build ecosystem resilience

Objective 5c: Improve coral reef habitat quality and restore ecosystem function.

Activity 1: Communicating Coral Disease as a Threat

Ensure that coral reef management and conservation programs at both the jurisdictional and national levels include SCTLD and coral disease as a threat to coral reefs when communicating to the public about coral reef health and conservation. Disease should be included as one of the many threats that work in concert to degrade the health and sustainability of coral reef ecosystems.

Activity Lead

Jurisdictional coral reef conservation or disease coordinators, National Coral Disease Coordinator, NOAA Coral Reef Conservation Program

Potential Activity Partners

U.S. Coral Reef Task Force Coral Disease Working Group, jurisdiction natural resource management agencies, NOAA Coral Reef Conservation Program Communications lead

Budget

Total: \$0- Should be incorporated into existing efforts without incurring additional costs

Potential Funding Sources

N/A

Description of Efforts

Local and federal agencies have protocols in place to respond to emergencies to coral reefs. These protocols should now include SCTLD as a threat and an emergency. As such, all outreach and communication activities to the general public should also include information and guidance regarding the SCTLD, including ways to recognize and report the disease.

Timeline

Ongoing

Measurable Outcomes

1. Coral reef outreach and education materials communicate SCTLD as a threat and emergency

Activity 2: Integrating Coral Disease into Restoration Plans

Integrate SCTLD and coral disease into jurisdictional coral restoration plans.

Activity Lead

Jurisdictional coral reef coordinators and coral restoration coordinators

Potential Activity Partners

NOAA coral reef management and fisheries liaisons, key jurisdictional coral reef restoration conservation partners

Budget

Total: \$0 (in kind staff time)

Potential Funding Sources

N/A

Description of Efforts

Integrate preparedness for and response to coral disease into coral restoration plans that are currently being developed for each U.S. coral jurisdiction. Where disease exists, consider how impacts from the disease and the ongoing threat of the disease influences restoration decisions. In unaffected jurisdictions, plan for the potential arrival of a coral disease outbreak in restoration planning, making sure that disease is a factor that is considered.

Timeline

Ongoing as restoration plans are created and/or updated

Measurable Outcomes

1. Jurisdiction coral restoration plans considering coral disease

Goal 6: Use the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act and Section 7 Endangered Species Act consultations to ensure SCTLD is evaluated as part of the baseline environmental conditions, in addition to environmental consequences and cumulative impacts that may result from federal actions.

Objective 6b: Ensure that mitigation activities that result from consultations reflect SCTLD intervention and restoration best practices.

Activity 1: Integrate Sediment Research Findings into Avoidance Strategies for Coastal Construction Projects

Because SCTLD is a relatively new disease, there is still much to learn about disease dynamics, including factors that contribute to disease transmission and coral susceptibility. As scientific understanding of SCTLD continues to improve, there is a need to incorporate research findings into construction project consultations to ensure that projects and associated mitigation are conducted in a manner that will avoid and minimize the likelihood of SCTLD infection and spread. This activity will integrate research findings, particularly those identified under Goal 1 of this implementation plan, into project consultations to minimize the potential for SCTLD infection and spread related to dredging projects.

Activity Lead

National Marine Fisheries Service Southeast Regional Office (SERO)

Potential Activity Partners

NOAA Atlantic Oceanographic and Meteorological Laboratories, universities, Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission, Mote Marine Lab, action agencies (e.g., U.S. Army Corps of Engineers)

Budget

N/A

Potential Funding Sources

N/A

Description of Efforts

Because SCTLD is a relatively new disease, there is still much to learn about disease dynamics, including factors that contribute to disease transmission and coral susceptibility. As scientific understanding of SCTLD continues to improve, there is a need to incorporate research findings into construction project consultations to ensure that projects and associated mitigation are conducted in a manner that will avoid and minimize the likelihood of SCTLD infection and spread.

Under this activity, literature and research findings on SCTLD will be reviewed including research identified under Goal 1 of this plan. SCTLD literature will be incorporated into analyses of project effects on corals. Project leads will work with action agencies to design or modify projects to avoid or minimize the likelihood of SCTLD infection and transmission. Minimization strategies will be incorporated into requirements and recommendations of project consultations.

Timeline

Ongoing

Measurable Outcomes

1. Project requirements and recommendations that will avoid and minimize the likelihood of SCTLD infection and transmission
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Objective 6b: Ensure that mitigation activities that result from consultations reflect SCTLD intervention and restoration best practices.

Activity 2: SOPs for SCTLD Monitoring Before and During Coastal Development Activities

Develop standard operating procedures (SOPs) for monitoring SCTLD prevalence before and during coastal development activities (e.g., dredging) that cause sediment suspension and transport in the water column. Develop the acceptable limits of change in SCTLD prevalence and identify SCTLD conditions requiring corrective actions to the coastal development activity to prevent or minimize SCTLD spread. Implement or support the implementation of the SOPs at priority coastal development project sites.

Activity Lead

External expert with experience conducting surveys and associated data management and reporting, supported by NOAA's National Marine Fisheries Service

Potential Activity Partners

U.S. Army Corps of Engineers, Florida Fish and Wildlife Conservation Commission, Florida Department of Environmental Protection

Budget

Total: \$30,000 for a four-month contract to contract the development of SOPs and provide recommendations for acceptable limits of change

Description of Efforts

Evaluate literature and coordinate closely with SCTLD monitoring and surveillance experts to identify current monitoring techniques and procedures to detect SCTLD prevalence and spread. Coordinate with activities conducted under Goal 1 to make sure that any procedures developed inform/are incorporated into the development of SOPs for both projects. Adapt identified monitoring techniques for monitoring of coastal development projects. Incorporate findings from research and monitoring projects to define acceptable limits of change and identify potential conditions needing corrective actions. Draft and implement SOPs. Evaluate effectiveness of SOPs at priority coastal development project sites.

Timeline

Months 1-4: Develop SOPs and recommendations

Months 5-17: Evaluate SOPs

Measurable Outcomes

1. Development of monitoring protocols and acceptable limits of change that result in adaptive management to minimize the chances of spread of SCTLD from coastal development projects.

Activity 3: SCTLD Best Management Practices for Mitigation

Based on what we know and learn about SCTLD, develop best management practices (BMPs) for mitigation, including compensatory mitigation (e.g., timing, siting, preferred species, density), and update BMPs as needed. BMPs are tailored to disease zones (e.g., endemic vs. pre-invasion), jurisdictions (e.g., Florida vs. the U.S. Virgin Islands), and intervention strategies, in case outbreaks occur during mitigation implementation.

Activity Lead

NOAA National Marine Fisheries Service fisheries liaisons for U.S. Virgin Islands, Puerto Rico, and Florida

Potential Activity Partners

NOAA Restoration Center, The Nature Conservancy, Florida Department of Environmental Protection's Coral Reef Conservation Program, Mote Marine Lab, Coral World

Budget

Total: \$60,000

Potential Funding Sources

Included within staff time

Description of Efforts

Produce BMPs via the following steps: 1) compile information on the state of knowledge of coral relocation and restoration in light of SCTLD at the different jurisdictions (Florida, Puerto Rico and the U.S. Virgin Islands), 2) meet with identified partners to identify gaps in knowledge, 3) attend large-scale port project meetings to assist in the compensatory mitigation planning process, as well as any other meetings with potential to assist in developing the BMPs (e.g. Florida Fish & Wildlife Conservation Commission Coral Rescue efforts, NOAA's Mission Iconic Reefs), 4) write the first draft of the BMPs, 5) present the BMPs (e.g., in a webinar) to get feedback from restoration practitioners, and 6) conduct a post-assessment survey of the BMPs to produce a final report (e.g., NOAA Tech Memo), which can assist in their successful implementation. These BMPs are expected to assist conservation efforts for Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultations in the Atlantic and Caribbean regions.

The state of knowledge will be a continuous process where information is compiled and updated from published studies, reports, and relevant meetings the team will be attending. The partners will be groups and organizations that are currently conducting research and restoration of corals taking into consideration the presence of SCTLD. Some of the partners/groups include the Disease Advisory Committee (both in Florida and the U.S. Virgin Islands), the Coral Rescue team, the Virgin Islands - Restoration of Corals Squad, The Nature Conservancy, and Coral World. Attending southeast Florida port project meetings will ensure that compensatory mitigation plans are taking into consideration the most up-to-date information on SCTLD intervention and minimization measures as well as identifying areas of need. Presenting the BMPs in a webinar will allow for initial feedback on the draft BMPs, which will be followed by a review process.

Timeline

Months 1-12: Gather information and update state of knowledge

Months 1-9: Meet with partners (e.g., DAC, coral rescue); attend port project meetings

Months 3-9: Write first draft BMPs

Months 7-9: Conduct internal review of BMPs draft

Month 8: Present BMPs in a webinar

Months 10-11: Develop BMPs final draft

Month 12: Conduct post-BMPs assessment (e.g., survey)

Measurable Outcomes

1. Development of BMPs for mitigation activities, which reflect the most up to date SCTLD minimization and intervention strategies
2. Communication of BMPs and engagement with internal (NOAA) and external partners across affected jurisdictions

3. Results from a post-assessment survey with key partners and restoration practitioners regarding the use and implementation of the BMPs developed. The results will also help identify whether there are additional gaps in knowledge that need to be addressed.
4. Integration of the BMPs in NOAA's conservation recommendations for compensatory mitigation in ESA and ESA consultations, particularly for large-scale port projects planned for southeast Florida.

Activity 4: Increase Engagement between SCTL D Scientists and Regulators

Increase opportunities for engagement between SCTL D scientists, regulators, and project proponents, ensuring that a representative from the U.S. Army Corps of Engineers (USACE) serves on the U.S. Coral Reef Task Force Coral Disease Working Group and that SCTL D communications are distributed to the USACE.

Activity Lead

National Coral Disease Coordinator, National Marine Fisheries Service Southeast Regional Office (SERO)

Potential Activity Partners

U.S. Coral Reef Task Force Steering Committee, Coral Disease Working Group, U.S. Army Corps of Engineers (USACE)

Budget

\$0

Potential Funding Sources

N/A

Description of Efforts

In the regulatory environment, NOAA works with other agencies that have different mandates and little to no exposure to information on SCTL D. Therefore, NOAA staff frequently serve as key messengers to these groups on SCTL D-relevant topics. To have an informed regulatory body, additional opportunities are needed for engagement between SCTL D scientists, regulators, and project proponents.

Work with the U.S. Coral Reef Task Force Steering Committee to identify a representative from the USACE to serve on the Disease Work Group. Distribute SCTL D communications to the USACE. Continue to provide presentations and information to the Interagency work group for large development projects such as the Port Everglades expansion project.

Timeline

Ongoing

Measurable Outcomes

1. USACE representative on USCRTF Coral Disease Working Group
2. SCTL D material and updates distributed to USACE
3. Presentations on coastal developments given to Working Group by USACE

Goal 7: Strengthen and expand international partnerships for SCTLD surveillance and sharing of data, best practices, and resources

Objective 7a: Prepare unaffected international jurisdictions for surveillance and intervention response.

Activity 1: Incorporating SCTLD into the International Coral Reef Initiative (ICRI)

Incorporate SCTLD efforts, needs, and capacity building into the ICRI platform to raise awareness of SCTLD and share information on coral disease preparedness and response.

Activity Lead

NOAA Coral Reef Conservation Program, International Coral Reef Initiative Secretariat

Potential Activity Partners

Department of State, International Coral Reef Initiative Member Nations

Budget

Total: \$15,000 (translation of materials, disease response coordination staff travel to attend ICRI event, costs associated with a side meeting)

Description of Efforts

Coordinate with NOAA Coral Reef Conservation Program leadership, the Department of State and ICRI Secretariat to incorporate SCTLD into ICRI's Platform and information regarding the disease into the ICRI State of the Reef Report. Translate relevant SCTLD materials into other languages as needed. Host an SCTLD-related side event at the ICRI meeting.

Timeline

1-3 months: Meeting with NOAA Coral Reef Conservation Program leadership to create actionable plan to include SCTLD in the ICRI Platform

Measurable Outcomes

1. SCTLD incorporated into ICRI Platform

Objective 7b: Increase international capacity for and coordination of surveillance, data collection, rescue, communications, and response planning.

Activity 1: Coordination of Caribbean Cooperation Team

Provide leadership and coordination support for the SCTLD Caribbean Cooperation Team and partner with regional organizations to track disease spread and distribute information; share lessons learned from ongoing response efforts including intervention and treatment techniques; share key informational products for distribution in the region; build capacity for SCTLD detection and response in the region; and identify potential resources to support detection and response activities in the Caribbean region.

Activity Lead

NOAA Coral Reef Conservation Program

Potential Activity Partners

Atlantic and Gulf Rapid Reef Assessment (AGRRA), Caribbean Cooperation Team member organizations including: Gulf and Caribbean Fisheries Institute/MPAConnect, The Nature Conservancy, Smithsonian Healthy Reefs Initiative, U.K. Overseas Territories, Netherlands Antilles, United Nations Environmental Program (UNEP) Caribbean Environmental Program, Association of Zoos and Aquariums, and various Florida response partners

Budget

Year 1: \$20,000
 Year 2: \$20,000
 Year 3: \$20,000
 Year 4: \$20,000
 Year 5: \$20,000
 Total: \$100,000

Potential Funding Sources

NOAA Coral Reef Conservation Program (CRCP), Caribbean international government partners (UNEP, UK, Netherlands, France)

Description of Efforts

This activity supports the ongoing coordination of the SCTLD Caribbean Cooperation Team (CCT) which was established as a component of the state of Florida's organized multi agency response to the outbreak of SCTLD on Florida's coral reef. The CCT is co-lead by NOAA CRCP and AGRRA. The CCT will continue to engage partners at two different levels of participation to achieve its goals related to information sharing and capacity building in the face of SCTLD. There is a core team of approximately 30 members who represent organizations that are working at a regional or subregional level on SCTLD efforts in the Caribbean. This team meets monthly. Every other month meetings focus primarily on information sharing regarding SCTLD in the region and participation is expanded beyond the 30-member core team to include 200+ managers, scientists and disease response practitioners working on SCTLD on coral reefs across the region.

Meetings and potential workshops and webinar sessions organized by the team will be used to achieve the following objectives: 1) partner with regional networks and initiatives to track disease spread and distribute information; 2) share lessons learned from ongoing response efforts including intervention and treatment techniques; 3) share key informational products for distribution in the region; 4) build capacity for SCTLD detection and response in the region; and 5) identify potential resources to support detection and response activities in the Caribbean region.

Timeline

Ongoing: Monthly meetings

Measurable Outcomes

1. Level of participation

Activity 2: International Caribbean Coral Rescue

Provide training and technical assistance to support the development and implementation of international coral reef rescue initiatives to support future coral propagation and restoration efforts in places that have been impacted by SCTLD.

Activity Lead

MPAConnect, NOAA Coral Reef Conservation Program

Potential Activity Partners

Caribbean Cooperation Team, MPAConnect, National Association of Zoos and Aquariums, Atlantic and Gulf Rapid Reef Assessment, NOAA Coral Reef Conservation Program, NOAA National Marine Fisheries Service, Florida Fish and Wildlife Conservation Commission

Budget

Total: \$40,000 (\$10,000 to support time of MPA Connect staff, \$30,000 to support participant travel to in-person training)

Description of Efforts

Host an SCTLD coral rescue workshop targeted at coral managers and practitioners in the Caribbean. The workshop should include an overview of coral rescue and presentations from throughout the region highlighting different iterations of coral rescue programs with different goals and methods. For those interested in receiving additional technical information and support in developing their own coral rescue program, host an in-person workshop at the Reef Futures conference, supporting travel costs for international participants. Provide additional coral rescue training/support to international partners as requested

Timeline

Months 1-4: Plan virtual workshop

Month 4: Host virtual workshop

Months 5-8: Plan in-person workshop at Reef Futures

Month 9: In-person workshop at Reef Futures

Months 4-Onward: Provide support to international partners as requested

Measurable Outcomes

1. Number of participants at workshops
2. Reported increase in coral rescue knowledge among workshop participants
3. Increase in planning efforts among international partners for coral rescue
4. Increased number of corals rescued in the international Caribbean

Activity 3: SCTLD Training and Technical Assistance for the International Caribbean

Work with regional partner organizations and initiatives including AGRRA, MPAConnect, and the SCTLD Caribbean Cooperation Team to provide information, training and technical assistance for Caribbean jurisdictions to support their efforts to monitor coral reefs for SCTLD, and to prepare for and respond to SCTLD outbreaks.

Activity Lead

NOAA Coral Reef Conservation Program

Potential Activity Partners

Atlantic and Gulf Rapid Reef Assessment (AGRRA), MPAConnect, Caribbean Cooperation Team

Budget

Year 1: \$160,000

Year 2: \$160,000

Year 3: \$160,000

Year 4: \$160,000

Year 5: \$160,000

Total: \$800,000

Potential Funding Sources

NOAA Coral Reef Conservation Program, NOAA International, USAID, Caribbean international government partners (UNEP, UK, Netherlands, France)

Description of Efforts

Track the status of SCTLD throughout the Caribbean region. AGRRA will continue to lead this effort by managing an online data reporting systems and data dashboard and collaborating with partners across the region to get updated information on SCTLD status and response efforts.

Implement training to support SCTLD response efforts. An annual workshop will be held to pull together SCTLD response partners across the wider Caribbean region and provide targeted training in SCTLD prevention, monitoring, treatment, and other response topics as needed such as coral rescue, restoration, response planning, etc. Workshops will be followed by technical support to a subset of participants to support implementation workshop outcomes.

Conduct outreach and develop SCTLD communications materials. Outreach materials such as videos, posters, social media content, and FAQ documents will be produced and distributed so that they may be directly used and/or adapted to support efforts by coral reef managers and disease response practitioners to communicate with a variety of audiences (stakeholders, government leadership, and funders) regarding SCTLD, its impacts, and needs to support effective response efforts.

Timeline

Ongoing with an annual workshop.

Measurable Outcomes

1. Annual workshop participation
2. Workshop products, including SCTLD response plans
3. Outreach products
4. Number of reports submitted thru AGRRA online reporting system

Goal 8: Work with relevant partners to prevent the spread of SCTLD to the four U.S. coral reef jurisdictions and Freely Associated States in the Indo-Pacific region

Objective 8a: Continue to promote best management practices for ballast water treatment with the maritime industry domestically and internationally, and continue support for research on the connection between ballast water treatment and other sea systems.

Activity 1: Ballast Water Best Management Practices

Provide recommendations for the development, revision, and promotion of best management practices (BMPs) and ballast water treatment based on current and emerging research on transmission of SCTLD in ballast water. Ensure the BMPs are consistent with the Vessel Incidental Discharge Act (VIDA).

Activity Lead

Environmental Protection Agency; U.S. Coast Guard, NOAA Coral Reef Conservation Program

Potential Activity Partners

U.S. Coral Reef Task Force Coral Disease Working Group Transmission Team

Budget

Total: \$0

Potential Funding Sources

N/A

Description of Efforts

Mandatory and voluntary BMPs intended to mitigate the threat of SCTLD transmission have been developed and distributed to the maritime industry via a Marine Safety Information Bulletin (MSIB) issued by the USCG in 2019. The MSIB advised mariners of the disease outbreak, included information about ballast water management regulations, and recommended the use of voluntary ballast exchange practices that would help reduce the threat of disease transmission. As part of this activity, leads will continue to promote the MSIB among the maritime industry, updating the BMPs as appropriate with the results of new research on SCTLD transmission and treatment methods. Once VIDA regulations are enacted, BMPs will be updated to ensure consistency. Other BMPs will be developed as appropriate.

Timeline

Ongoing

Measurable Outcomes

1. Updated BMPs aimed at reducing SCTLD transmission
2. Increase in number of mariners receiving BMPs

Activity 2: Building Partnerships for Ballast Water Management

Collaborate with existing regional and international institutions - such as the International Maritime Organization, the International Ballast Water Management Convention, and both the National and Regional Invasive Species Councils - to disseminate existing and future SCTLD BMPs, promote regional collaboration on SCTLD, and develop and implement regional approaches to prevention (i.e., Caribbean countries could strengthen regional requirements under the International Ballast Water Management Convention).

Activity Lead

National Coral Disease Coordinator; Environmental Protection Agency; U.S Coral Reef Task Force Coral Disease Working Group Transmission Team; U.S. Coast Guard; Coral Disease Associate, NOAA Coral Reef Conservation Program

Potential Activity Partners

U.S. Coast Guard Office of Operating and Environmental Standards (CG-OES)

Budget

Year 1: \$5,000

Year 2: \$5,000

Year 3: \$5,000

Year 4: \$5,000

Year 5: \$5,000

Total: \$25,000

Description of Efforts

Identify a group of regional and international institutions that play a role in ballast water management and/or the control of aquatic invasive species. Conduct outreach to these institutions, disseminating relevant information about SCTLD and BMPs. Establish partnerships focused on regional and international collaboration on SCTLD and preventing the spread of aquatic invasives. Identify avenues for stronger regulations and best management practices regarding ballast water discharge. Ensure that new and updated BMPs are shared with these institutions.

This activity depends on outcomes from several other activities, particularly an evaluation of existing regulatory and legal frameworks and research to inform future changes to BMPs.

Timeline

Months 1-4: Identify relevant institutions

Months 5-Onward: Conduct outreach to institutions, build partnerships and disseminate SCTLD info and BMPs as appropriate. Identify strategies to help prevent transmission.

Measurable Outcomes

1. Existing BMP promotion
 2. Future BMP promotion
 3. Promote regional SCTLD collaboration
 4. Development of partnerships with regional and international institutions
 5. Development and implementation of regional approaches to prevention
 6. Strengthening regional requirements under the International Ballast Water Management Convention in the Atlantic and Caribbean region
-

Objective 8b: Work with the EPA, U.S. Coast Guard and jurisdictional environmental enforcement authorities to promote active enforcement of existing regulations as they pertain to ballast water discharge under current regulations and future regulations under the Vessel Incidental Discharge Act (VIDA).

Activity 1: Enhance Maritime Transportation Compliance with Existing Regulatory Requirements to Prevent SCTL D Transmission

Evaluate existing regulatory requirements and use available legal frameworks across federal agencies to prevent SCTL D transport from the Caribbean to Pacific, ensuring vessels meet existing regulatory requirements and determining if additional steps may be taken under emergency provisions.

Activity Lead

U.S. Coast Guard, NOAA Coral Reef Conservation Program

Potential Activity Partners

U.S. Coral Reef Task Force Coral Disease Working Group, NOAA, Environmental Protection Agency

Budget

Total: \$0

Potential Funding Sources

N/A

Description of Efforts

Coordinate ballast water enforcement actions between USCG Headquarters Program Office, District 7 (Florida and Caribbean), District 14 (Hawaii, Guam, and U.S. Pacific Island Territories), and participating Field-level USCG Sectors and Marine Safety Units and Detachments. Invite EPA to USCG monthly group meeting of Coast Guard SCTL D Task Force. Ensure active collaboration and communication between the Coast Guard SCTL D Task Force and USCRTF Coral Disease Working Group.

Timeline

Month 1: Establish USCG Task Force for Hawaii, Guam, Puerto Rico, and Florida (Miami)

Month 2: Initiate tracking document for BW compliance monitoring

Month 8: Establish BW screening programs at each sector

Measurable Outcomes

1. Improve targeting of noncompliant vessels
2. Improve quality/accuracy of submitted ballast water reports
3. Advertise enforcement actions and penalties to the broader shipping community
4. Identify candidates for testing field-level ballast water sampling and analysis tools

Activity 2: Understanding VIDA's Implications for SCTL D

Once the Vessel Incidental Discharge Act (VIDA) is enacted, evaluate the implications of new regulations on SCTL D transmission and support the development of agency-level guidelines that implement VIDA rules and regulations in a manner that minimizes SCTL D transmission.

Activity Lead

U.S. Coast Guard Office of Operating & Environmental Standards (OES), Environmental Protection Agency

Potential Activity Partners

Coast Guard SCTLD Task Force, U.S. Coral Reef Task Force Coral Disease Working Group

Budget

Total: \$0

Potential Funding Sources

N/A

Description of Efforts

The Vessel Incidental Discharge National Standards of Performance Act (VIDA) is expected to be enacted in 2022. The proposed rules would reduce the environmental impact of discharges, such as ballast water, that are incidental to the normal operation of commercial vessels. When finalized, the new rules will streamline the current patchwork of federal, state, and local requirements that apply to the commercial vessel community and better protect our nation's waters.

VIDA has significant implications related to preventing the spread of the prevention of spread of SCTLD. EPA is responsible for developing uniform national standards of performance for VIDA and USCG is charged with developing and implementing regulations to ensure, monitor, and enforce compliance with EPA standards within two years thereafter. Both EPA and USCG will be involved in carrying out VIDA via agency rules and regulations where they have discretion in how VIDA is implemented and enforced. Via close collaboration with relevant groups and organizations, EPA and USCG can ensure VIDA is implemented in a manner that minimizes risk of SCTLD transmission.

Timeline

After VIDA is enacted, which is expected to be later in 2022.

Measurable Outcomes

1. VIDA is implemented in a manner that minimizes the risk of SCTLD transmission

References

Studivan, M.S., Baptist, M., Molina, V., Riley, S., First, M., Soderberg, S., Rubin, E., Rossin, A., Holstein, D., & Enochs, I. (2022) PREPRINT (Version 1). Transmission of stony coral tissue loss disease (SCTLD) in simulated ballast water confirms the potential for ship-born spread. Scientific Reports. <https://doi.org/10.21203/rs.3.rs-1720701/v1>

Appendix II: Review team

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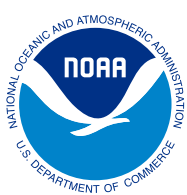
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Appendix III: Process timeline

Year	Month	Activity
2021	July	Core planning team convenes and identifies priority objectives from NOAA's SCTLD strategy to include in the implementation plan
2021	Aug-Sep	Core Planning Team develops activities to support priority objectives
2021	October	Core Planning Team conducts an internal review of all activity and incorporates suggested revisions
2021	Nov-Dec	Core Planning Team develops activity plans
2022	Jan-Mar	Core Planning Team conducts an internal review of all activity plans and incorporates suggested revisions
2022	April	Draft implementation plan is circulated to the broader review team
2022	May	U.S. Coral Reef Task Force Coral Disease Working Group reviews and discusses the draft plan
2022	May-Jun	Coral Planning Team incorporates suggested revisions from the broader review team and Coral Disease Working Group and finalizes draft language
2022	July-Aug	NOAA communications team designs document
2022	August	NOAA leadership reviews and approves implementation plan
2022	September	Implementation plan is published

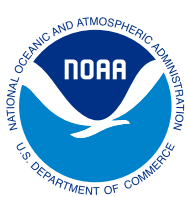


Appendix IV: Detailed budget table

Costs will be covered from a mix of existing and new private and public sector funds, as outlined in Appendix I.

Goal	Activity name	Required budget for implementation
1	Research Audit and Synthesis	\$1,075,000
1	Standard Operating Procedures for Sample/Data Collection/Intervention	\$1,100,000
1	Direct and Ecological Interventions	\$15,000,000
1	SCTLD Transmission Experiments	\$275,000
1	Risk Profile for Vessels	\$0
1	Identification of High-Risk Ports in the Pacific	\$0
1	Research for Coastal Construction SCTLD Impact Avoidance Strategies and Integration of Findings into Mitigation Efforts	\$200,000
1	Use Artificial Intelligence (AI) for SCTLD Detection	\$1,000,000
1	Evaluation of Coral Resilience and Resistance to SCTLD	\$30,000,000
1	Identification of Causation and Diagnostic Development	\$20,000,000
1	Evaluating the Susceptibility of Pacific Corals	\$100,000
1	SCTLD Surveillance in Panama	\$0
2	Partnerships with Regional Networks	\$3,000
2	SCTLD Preparedness in the U.S. Indo-Pacific	\$93,000
2	Interjurisdictional Collaborative Workshops	\$375,000
2	Pacific Preparedness Workshops and Trainings	\$330,000
2	Engaging Sea Grant Programs in SCTLD Response and Prevention	\$200,000
2	Annual Response Planning Workshops for Affected Jurisdictions	\$225,000
2	Preparedness and Surveillance Planning-Unaffected Jurisdictions	\$360,000
2	Monitoring and Surveillance for SCTLD in Affected and Unaffected Jurisdictions	\$1,180,000
2	Pacific Coral Disease Dashboard and Information Portal	\$155,000
2	NOAA SCTLD Response Gap Analysis	\$200,000
2	Guidelines for Environmental Compliance Review of NOAA-funded SCTLD Projects	\$0
2	Treatment and Intervention in Affected Jurisdictions	\$1,500,000
2	NOAA Diver Decontamination Protocols	\$0
2	National Coral Disease Coordination Capacity	\$1,350,000
2	Disease Response in Flower Garden Banks National Marine Sanctuary	\$625,000
2	Supporting Citizen Science in Jurisdictions	\$245,000
3	Coral Rescue Coordinator	\$900,000

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Goal	Activity name	Required budget for implementation
3	U.S. Caribbean Coral Rescue Workshop	\$80,000
3	Establishment of Land-Based Coral Nurseries	\$28,200,000
3	Technical Assistance for Rescue, Propagation, and Restoration	\$7,300,000
3	Coral Rescue and Restoration Database	\$270,000
4	National SCTLD Communications Strategy	\$30,000
4	Jurisdiction Communications and Outreach Plans	\$150,000
4	SCTLD Newsletter and Monthly Updates	\$40,000
4	Annual SCTLD Report	\$15,000
4	U.S. Coral Reef Task Force Coral Disease Working Group	\$250,000
5	Communicating Coral Disease as a Threat	\$0
5	Integrating Coral Disease into Restoration Plans	\$0
6	Integrate Sediment Research Findings into Avoidance Strategies for Coastal Construction Projects	\$0
6	SOPs for SCTLD Monitoring Before and During Coastal Development Activities	\$30,000
6	SCTLD Best Management Practices for Compensatory Mitigation	\$60,000
6	Increase Engagement Between SCTLD Scientists and Regulators	\$0
7	Incorporating SCTLD into the International Coral Reef Initiative (IRCI)	\$15,000
7	Coordination of Caribbean Cooperation Team	\$100,000
7	International Caribbean Coral Rescue	\$40,000
7	SCTLD Training and Technical Assistance for the International Caribbean	\$800,000
8	Ballast Water Best Management Practices	\$0
8	Building Partnerships for Ballast Water Management	\$25,000
8	Enhance Maritime Transportation Compliance with Existing Regulatory Requirements to Prevent SCTLD Transmission	\$0
8	Understanding VIDA's Implications for SCTLD	\$0
	NOAA Center of Excellence for Marine Disease Investigations	\$11,104,000
	TOTAL	\$125,000,000

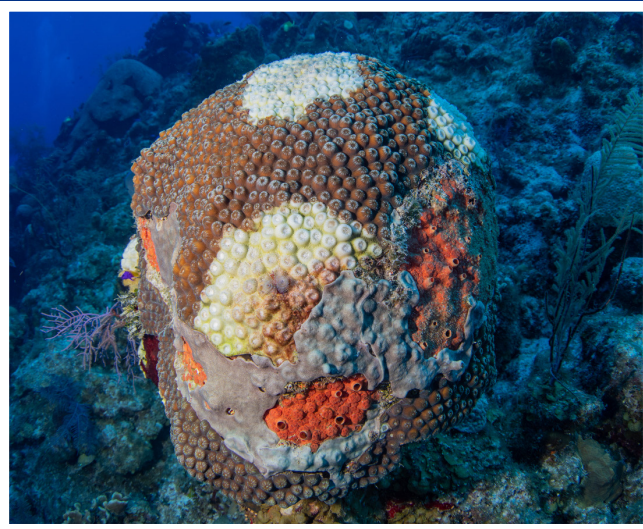


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