Stony Coral Tissue Loss Disease Management Letter for the Dutch Caribbean
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Coral reefs constitute less than 2% of the ocean floor, yet serve as an important part of the oceanic ecosystem. They provide shelter, food and breeding grounds for a wide variety of organisms, as well as a way for storm wave energy to dissipate before hitting the coast, preventing erosion and coastal morphodynamic alterations (NOAA, 2017).

A new coral disease was first spotted off the coast of Florida in 2014. Since then, it has spread throughout the Caribbean, including Mexico, Belize, Jamaica, Sint Maarten, the Dominican Republic, the Turks and Caicos Islands, St. Eustatius and the U.S. Virgin Islands, (AGGRA, 2019). This disease is known as Stony Coral Tissue Loss Disease (SCTLD). Scientists now believe this could be one of the deadliest disease outbreaks within corals ever recorded.

To date it has only been seen in stony corals and causes significant tissue loss within affected hosts. This disease spreads fast and can have devastating effects on the reef if not treated immediately (Florida DEP, 2019).

“It is a huge disaster that’s going on underneath the waves, this is on the level of the Amazon burning. It is on the level of a disease that’s wiping out all of America’s forests.”
- Karen Neely of Nova Southeastern University (Jackson, 2019)

“How do we keep from losing what was built over the last 8000 years? Because we don’t have another 8000 years to rebuild it.”
- Lauren Toth of U.S. Geological Survey (USGS) (Voosen, 2019)

“I have never seen anything that affects so many species, so quickly and so viciously - and it just continues. All the diseases I’ve studied in the past could be considered like the flu. They come every year, seasonally, and sometimes there are worse outbreaks. This thing is more like Ebola. It’s a killer, and we don’t know how to stop it.”
- Marilyn Brandt of the University of the Virgin Islands (Jackson & Prentice, 2019)
The purpose of this management letter is to:

- Provide background information on Stony Coral Tissue Loss Disease (SCTLD) outbreaks and current status within the Caribbean
- Assist marine park managers, government officials, coastal managers, divers and coastal residents by offering guidance on how best to identify and manage a SCTLD outbreak
- Provide information on how to identify, respond and treat known infections
- Present lessons learned from other islands to help properly manage SCTLD outbreaks within the Dutch Caribbean
- Present best practices for divers, fishermen and boaters to minimize spread of the disease
Background Information and Scope

Background Information

SCTLD was first identified off the east coast of Florida in 2014. So far, over 20 different species have been affected by this disease. This disease appears to be highly infectious, especially among brain, pillar, star and starlet corals (GCFI, 2019). Once a coral has been infected, there is a high transmission and mortality rate within the reef. Although coral disease within the Caribbean has become increasingly common, most diseases only affect a small number of species with episodic occurrences. SCTLD now appears to be bringing new challenges and greater impacts than other coral diseases as it is recurring each year and spreading at a very rapid pace.

Corals are already under immense pressure from the effects of global warming. Warmer ocean waters can lead to heat stress and bleaching which can weaken coral, making them more susceptible to disease (Martin, 2019). Furthermore, areas which have already suffered damage from hurricanes and tropical storms are at an additional risk for disease. The combination of these factors makes the coral reefs within the Caribbean a hotspot for disease which must be carefully managed and treated if they are to survive these changing conditions.

Below is a six-week time lapse photo of an infected coral off the coast of St. Thomas. As can be seen within this time period, nearly 100% of the coral has died off.

![Figure 1: 6-week time lapse of affected coral off St. Thomas (Martin, 2019) (Photo: Sonora Meiling)](image-url)
Regional Extent of the Issue

Since 2014, SCTLD has spread from Florida to the neighboring reefs of Jamaica, Mexico, St. Maarten, the Dominican Republic, the US Virgin Islands, the Turks and Caicos Islands, Belize and Sint Eustatius (AGGRA, 2019). This disease appears to be rapidly spreading over a wide geographical area. Scientists believe this is a water-borne disease which can also be spread through contact. Scientists also believe ballast water containing the pathogens and other anthropogenic sources which may travel between islands could further contribute to the spread of the disease. More research is needed to understand the impact of cruise ships, cargo ship ballast and vessel discharges on the spread of this disease.

Figure 2: Current SCTLD Map of the Caribbean (AGGRA, 2019)
Current Situation within the Dutch Caribbean

St. Maarten
In February of 2019, Nature Foundation St. Maarten published photographic evidence of SCTLD infections within local coral reefs. While reported cases were seen as early as October 2018, a recent 2019 survey found an infection and mortality rate of nearly 60% for the most susceptible stony corals within the Marine Park ‘Man of War Shoal’. Alarmingly, coral reefs outside of this Marine Protected Area had even higher infection rates of at least 70% (Nature Foundation St. Maarten, 2019). Scientists believe that a combination of previous hurricane damage, poor water quality, overfishing and climate change contributed to the weakened state of the corals making them more susceptible to this new disease.

“As always, we are working very hard to try to manage this disease and the additional challenges it has created, through our management actions. This includes trying to create extra reef habitat as part of the One Million Coral Initiative and adding epoxy mixed with antibiotics to affected coral. However, we urgently need the support of decision makers and the wider community to make sure that we can continue to address the challenges to the marine ecosystem head on. A sound wastewater infrastructure, holding those that dump wastewater in the ocean and wetlands accountable, increased monitoring, and a ban on single-use plastics and non-coral friendly sunscreen would go a long way,” commented Director of DCNA, Tadzio Bervoets

Saba and Saba Bank
As of October 2019, SCTLD had not yet reached the reefs of Saba and Saba Bank. The Saba Conservation Foundation, together with the University of Wageningen and the Institute for Marine Resources and Ecosystem Studies, have worked to set up a Global Coral Reef Monitoring Network (GCRMN) within these waters to survey and assess the health of local reefs (Henry, 2019). Programs such as these will serve as an early warning system if SCTLD spreads to these waters.

St. Eustatius
SCTLD has been detected in the northwestern section of the marine park. Researchers believe the first documented infection began in August 2019.

Aruba, Bonaire and Curacao
There is a suspected case of SCTLD off the coast of Aruba, but this has not yet been confirmed (AGGRA, 2019). Conservation groups are working to disseminate information to dive schools and visiting divers to minimize the risk of spreading the disease further. Local conservation groups, along with DCNA, are hoping with further monitoring surveys, if SCTLD is present, the disease can be managed and treated before spreading to neighboring reefs.
Partnerships

Local Partnerships

Identifying and protecting local reefs against SCTLD will require a coordinated effort by local conservation groups, government agencies and volunteers. This issue cannot be handled by a single entity and requires close coordination to minimize damage and maximize local response.

- Establish a management group, under the auspices of the DCNA Monitoring Committee, with key stakeholders and necessary resources
- Community engagement (business and tourism sector, non-governmental organizations, government agencies, etc.)
- Use existing communication channels to learn from and share information and experiences both locally and regionally.
- Identify monitoring protocols for new infections and treatment actions in order to minimize damage once SCTLD is detected

National and Regional Partnerships

Early detection is key in managing SCTLD outbreaks. Understanding how the disease progresses through the Caribbean will provide early warnings to currently uninfected reefs. Open communication and cooperation between the islands will be key in managing this Caribbean wide issue. National and Regional partners should:

- Share best practices and lessons learned in removal efforts (equipment, methods) to build regional capacity and develop region-wide best management practices
- Share ideas on how to detect and treat SCTLD
- Collaborate with regional institutions to consolidate regional efforts and garner external funding for focused monitoring and treatment interventions.
Outreach and Education

Stakeholder Participation

Anyone interacting in and around coral reefs are potential stakeholders when considering SCTLD outbreaks. From boat captains to scuba divers, full cooperation and engagement will be necessary to minimize the risk of spreading the disease. Meeting the wide range of needs from each of the stakeholders will require clear and open communication, particularly concerning when to empty ballast tanks and how to properly clean equipment between dives. When possible, stakeholders should also communicate directly with their island’s marine park management or National Authority when they suspect that they’ve encountered infected coral. Lastly, it is important to clearly communicate with the stakeholders prior to SCTLD being identified within local waters to ensure the possibility of introducing the disease is minimized.

- Reduce environmental impact: stakeholders must be properly trained to work in and around coral reefs, minimizing direct contact with the corals
- Communicate accurate, easy to understand information on SCTLD
- Suggest voluntary activities to usefully engage public participation
- Inform stakeholders about relevant regulations
- Share information on treatment and outbreak management best practices
Communications

Accurate and timely communicate with the public is critical in managing SCTLD outbreaks. It is important for all stakeholders to have a unified message and to ensure appropriate language is being used. To maximize the general publics understanding of the issue, it is recommended to minimize the use of abbreviations, acronyms and technical jargon. Recommended posters to help increase public awareness have been provided by MPACConnect and can be found in Appendices 1-3. MPACConnect has provided a helpful guide for clear scientific communication with the public (Doyle & O’Sullivan, 2019).

![Figure 3: MPACConnect Guide for Clear Scientific Communications](image)

### Stony Coral Tissue Loss Disease terminology for clear science communications

<table>
<thead>
<tr>
<th>MISLEADING LANGUAGE</th>
<th>MORE ACCURATE TO SAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>White disease</td>
<td>Tissue loss disease</td>
</tr>
<tr>
<td>SCTLD acronym</td>
<td>Coral disease affecting hard corals</td>
</tr>
<tr>
<td>Mysterious</td>
<td>Emerging, newly occurring disease</td>
</tr>
<tr>
<td>Unidentified</td>
<td>Named by scientists as stony coral tissue loss disease</td>
</tr>
<tr>
<td>Confused with other diseases</td>
<td>Shares similarities with some other coral diseases</td>
</tr>
<tr>
<td>Contagious</td>
<td>Spreads rapidly among stony corals but does not affect humans</td>
</tr>
<tr>
<td>Unknown disease</td>
<td>Scientists are working to document the outbreak and develop advanced treatments</td>
</tr>
<tr>
<td>Cause unknown</td>
<td>Partners regionally are researching the disease; Scientists are working to identify pathogen(s) responsible</td>
</tr>
<tr>
<td>Unmanageable</td>
<td>Targeted, strategic efforts</td>
</tr>
<tr>
<td>Closure of reef</td>
<td>Quarantine</td>
</tr>
<tr>
<td>Culling</td>
<td>Strategic removal or rescue</td>
</tr>
<tr>
<td>Use antibiotics</td>
<td>Strategic, small-scale application of Antibiotics</td>
</tr>
<tr>
<td>Uncertain about plans</td>
<td>Range of approaches needed</td>
</tr>
</tbody>
</table>

### Highly susceptible species

- *Montastrea cavernosa*
- *Euphyllia* spp.
- *Siderastrea* sp.
- *Diploria* spp.
- *Dendrogyra* cylindrus
- *Eusmilia* fastigiata
- *Meandrina* meandrites
- *Dichocoenia stokesii*
- *Colpophyllia natans*
- *Diploria labyrinthiformis*
- *Orbicella* species
- *Montastrea* sp.
- *Pseudodiploria clivosa*
- *Pseudodiploria strigosa*
- *Diploria* sp.

### What’s at stake?

Our highly diverse and economically valuable coral reef ecosystems.

### What can we do?

While the situation is urgent, it is not too late to save these incredibly important ecosystems. Corals are resilient if given the chance and the enabling conditions for their growth and survival.

The key is reducing local and global stressors to support reproduction, growth, and survival.
Identification of SCTLD

SCTLD can appear in a variety of different ways, whether it’s through the development of a single lesion or many lesions which can merge to consume the entire specimen (GCFI, 2019). Typically, tissue loss is first seen along the edge of the colony and spreads upwards, leaving behind a white skeleton. There have also been cases where tissue loss occurs in patches or blotches within the colony which expand in size until they merge together (Florida DEP, 2018). It is also possible for corals to be infected by multiple diseases at once, so symptoms may vary along the reef.

Onset of SCTLD appears to infect highly susceptible species first. The disease spreads rapidly with total mortality of infected specimens ranging between 1 week to 2 months (AGGRA, 2019). Typically, a month after the disease has been reported in highly susceptible species, it begins to infect intermediately susceptible species. Within these species, smaller colonies have been seen to die off over the course of months and larger colonies have been seen to host the disease for years without suffering complete mortality.

Highly Susceptible Species (AGGRA, 2019)

<table>
<thead>
<tr>
<th>Species 1</th>
<th>Species 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colpophyllia natans (Boulder Brain Coral)</td>
<td>Dendrogyra cylindrus (Pillar Coral)</td>
</tr>
<tr>
<td>Dichocoenia stokesii (Elliptical Star Coral)</td>
<td>Diploria labyrinthiformis (Grooved Brain Coral)</td>
</tr>
<tr>
<td>Eusmilia fastigiata (Smooth Flower Coral)</td>
<td>Meandrina meandrites (Maze Coral)</td>
</tr>
<tr>
<td>Pseudodiploria strigosa (Symmetrical Brain Coral)</td>
<td>Pseudodiploria clivosa (Knobby Brain Coral)</td>
</tr>
</tbody>
</table>

Intermediately Susceptible Species (AGGRA, 2019)

<table>
<thead>
<tr>
<th>Species 1</th>
<th>Species 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbicella annularis (Lobed star coral)</td>
<td>Orbicella faveolata (Mountainous Star Coral)</td>
</tr>
<tr>
<td>Orbicella franksi (Boulder Star Coral)</td>
<td>Montastraea cavernosa (Great Star Coral)</td>
</tr>
<tr>
<td>Solenastrea bournoni (Smooth Star Coral)</td>
<td>Stephanocoenia intersepta (Blushing Star Coral)</td>
</tr>
<tr>
<td>Siderastrea siderea (Massive Starlet Coral)</td>
<td></td>
</tr>
</tbody>
</table>
Presumed Susceptible (*but insufficient data to categorize onset*) (AGGRA, 2019)

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Agaricia agaricites</em> (Lettuce Coral)</td>
<td><em>Agaricia spp.</em> (Plate/Saucer Corals)</td>
</tr>
<tr>
<td><em>Mycetophyllia spp.</em> (Cactus Coral)</td>
<td><em>Madracis areniterna</em> (Pencil Coral)</td>
</tr>
<tr>
<td><em>Favia fragum</em> (Golfball Coral)</td>
<td><em>Helioseris cucullata</em> (Sunray Lettuce Coral)</td>
</tr>
<tr>
<td><em>Mussa angulosa</em> (Spiny Flower Coral)</td>
<td><em>Scolymia spp.</em> (Disc Coral)</td>
</tr>
<tr>
<td><em>Isophyllia spp.</em> (Sinuous Cactus Coral; Rough Star Coral)</td>
<td></td>
</tr>
</tbody>
</table>

Low Susceptible Species*: During outbreaks, the following corals have been recorded as rarely or not affected (AGGRA, 2019)

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Porites astreoides</em> (Mustard Hill Coral)</td>
<td><em>P. porites</em> (Finger Coral)</td>
</tr>
<tr>
<td><em>P. divaricata</em> (Thin Finger Coral)</td>
<td><em>P. furcata</em> (Branched Finger Coral)</td>
</tr>
<tr>
<td><em>Acropora palmata</em> (Elkhorn Coral)</td>
<td><em>A. cervicornis</em> (Staghorn Coral)</td>
</tr>
<tr>
<td><em>Oculina spp.</em> (Bush Corals)</td>
<td><em>Cladocora arbuscula</em> (Tube Coral)</td>
</tr>
</tbody>
</table>

*Although these corals are rarely affected, the disease might mutate to include these species in the future. It is important to monitor all corals to ensure SCTLD as not spread to healthy corals.

Detailed examples of healthy and infected coral species can be found on the AGGRA website for further clarification. Downloadable cards are also available which can be used in the field to help identify the disease. [https://www.agrra.org/coral-disease-identification](https://www.agrra.org/coral-disease-identification)
Response and Treatment Options of SCTLD

Effective management of the monitoring and treatment process requires that clear selection criteria for the prioritization of SCTLD-affected coral reef sites be established early. MPACoNnect recommends prioritizing large coral colonies in close proximity to others of the same species (Doyle & O’Sullivan, 2019). It is also recommended to prioritize large colonies which still retain a significant portion of healthy tissue with small numbers of lesions, which will be more easily treated. In addition, coral reef sites which have the highest likelihood of responding positively to treatment should be prioritized. This would include sites which hosted healthy reefs and water conditions prior to the SCTLD detection. Sites which have additional stressors, such as high levels of tourism or fishing pressures, may not respond as well to treatment.

The following actions are recommended for the identification and response to a SCTLD outbreak (Florida DEP, 2019).

**Divers**
- Conduct AGRRA Roving Diver surveys to identify affected areas (prior to known infection)
- Minimize contact with infected corals
- Dive clean reefs before diving infected reefs to help prevent spread
- Decontaminate gear after diving

**Scientific Analysis**
- Conduct coral disease surveys and site monitoring
  - Document spatial extent, mortality rates and species impacted using AGRRA specified Roving Diver Methodology
- Collect tissue samples for analysis
  - If possible, field samples of infected species should be collected to test for disease pathogens
- Data Management and Analysis
  - Properly record and manage data sets to better understand factors influencing disease propagation (Record GPS location)
- Intervention experiments and field trials
  - Try intervention and treatment techniques to minimize spread of the disease

**All Stakeholders**
- Encourage open communication throughout the Caribbean to track the spread of the disease and provide insight into effective prevention and treatment methods
- Improve overall health of the reef to make it more resilient to disease outbreaks.

If divers suspect they may have encountered an infected coral colony, it is recommended that a report be submitted through the AGGRA website. It is encouraged to document the date, GPS location, species (if possible) and to photograph the specimen for the report.

https://www.agrra.org/experimental-interventions
Monitoring

Monitoring local reefs is crucial in early detection and holistic management of SCTLD outbreaks. The following table outlines the recommended multi-step monitoring approach, as recommended by MPAConnect (Doyle & O’Sullivan, 2019).

Table 1: MPAConnect Recommended Monitoring Approaches.

<table>
<thead>
<tr>
<th>Management need</th>
<th>Recommended monitoring approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define broad spatial limits of disease</td>
<td>Manta tows, stakeholder reporting</td>
</tr>
<tr>
<td>Approximate prevalence of SCTLD</td>
<td>Roving diver surveys</td>
</tr>
<tr>
<td>Track progression of SCTLD</td>
<td>Marked colonies, establish sentinel reef sites, photo series</td>
</tr>
<tr>
<td>Quantify spatial extent of SCTLD</td>
<td>AGRRA-type surveys (or standard national protocol)</td>
</tr>
<tr>
<td>Assess SCTLD interventions</td>
<td>Visual inspection of treated lesions, photo series</td>
</tr>
<tr>
<td>Determine impacts on coral reef ecosystems including fish</td>
<td>6-monthly repeat of AGRRA-type surveys at long-term monitoring sites affected and unaffected by SCTLD</td>
</tr>
</tbody>
</table>

Monitoring the reef can be an effective way to:

1. Identify early signs of the disease
2. Document the progression of the disease
3. Quantify the spatial extent of the SCTLD outbreak

Protocols for each of these monitoring objectives can be found in the appendix 4.

Early detection and effective reporting are crucial in the management of SCTLD outbreaks.
Topical Antibiotic Treatments

Ideally, once SCTLD is detected, it should be treated as quickly and aggressively as possible to minimize the risk of spreading. A field study off the coast of Florida found the application of amoxycillin powder with CoreRx Base2B to be highly affective (Neely, 2019). This study also found that areas surrounding the treated portion of coral were protected from further lesion mortality for up to two months after application (Neely, 2019).

Although this technique has been found to be successful, regulatory framework for the use of antibiotic treatment varies between each country. It should also be noted that this technique has had best results for small lesions (less than 5cm). The response also appears to be species specific, so results may vary. In addition, this method can only treat a specific lesion, so even after receiving treatment, new lesions may arise within the colony. Careful monitoring and reapplication will most likely be necessary for ongoing protection (Florida DEP, 2018).

MPAConnect recommends the following considerations for selecting which corals to treat (Doyle & O’Sullivan, 2019):

1. Selecting colonies where more than 75% of the corals are still alive, this will maximize the likelihood that the colony will survive the infection post treatment.

2. Select colonies with the fewest active SCTLD legions. Since each lesion will require follow-up treatment, colonies with the most legions and therefore poorer overall health will have the lowest chance of recovery. Recommend selecting colonies with less than 5 treatable lesions.

3. Monitoring efficiency, select colonies in proximity to other treated corals, sites, or ongoing projects which will be easily monitored after treatment.

4. Suitability for treatment, some colonies may be immediately disqualified for treatment given other external factors such as feasibility, location, or if the coral is attached to something sensitive such as equipment or a cultural resource.

After treatment is applied, it is recommended that photographs be taken to monitor the progression of the disease every 2-weeks until the lesions are no longer visible.

The protocol for applying this treatment can be found in Appendix 5.
**Best Practices**

**Divers and Snorkelers (Florida DEP, 2019)**
- The pathogen has been identified to particularly adhere to neoprene. Special attention should be given to wetsuits, gloves, hoodies, booties and BCD bladders
- Carefully inspect dive gear and equipment to remove any debris after diving
- Move down current from uninfected sites to infected sites
- Decontaminate dive gear after every dive
  - Soak gear in a decontamination solution for 10 minutes
    - Non-sensitive gear (tools) should be soaked in a 1% bleach solution
    - Fins, mask, wetsuit, BCD should be soaked in quaternary ammonium disinfectant (Lysol or Dettol are good examples of this)
    - Dive computer, regulators and other electronics should be soaked for 20 minutes using antibacterial dish soap
  - Rinse all gear in fresh water
  - Allow gear to fully air dry before repeated use
- Ensure that disinfectant and rinse water is properly disposed of once decontamination of gear is completed
- Proper buoyancy control is critical while diving on the reef to minimize contact with infected corals

**Fishing (Florida DEP, 2019)**
- Use circle hooks (if possible) to minimize damage to fish once released
- If bottom fishing, use braided line and a leader lighter than the breaking strength of the line to minimize line left on the reef if snagged.
- Minimize number of fish removed from the water, a healthier reef fish population contributes to a healthy reef which may be more resilient to fighting off disease

**Boating (Florida DEP, 2019)**
- Minimize direct interaction with the reef (anchoring and accidental collision)
- Avoid emptying ballast tanks in near shore environments and adhere to national regulations as it pertains to the release of ballast water
- Wash boat carefully, including the bilge, before moving between areas
- Avoid overfilling fuel and oil to minimize spills

**Everyone**
Even if you aren’t directly interacting with the reef, you can still contribute to better reef health by participating in beach clean ups, recycling, conserving water and minimizing excessive fertilization of gardens near the coastlines.
Frequently Asked Questions

**What is SCTLD?**
STCLD stands for Stony Coral Tissue Loss Disease and is a highly infection disease spreading among stony corals within the Caribbean. This disease is known to infect over 20 different species of coral.

**What areas are infected with SCTLD?**
Currently, SCTLD has been identified in reefs of Mexico, Belize, Jamaica, Sint Maarten, the Dominican Republic, the Turks and Caicos Islands, St. Eustatius and the U.S. Virgin Islands, (AGGRA, 2019).

**Is this disease dangerous to humans or other marine life?**
No, this disease only affects corals. However, humans and other marine life can contribute to the spread of the disease, so interactions with infected species should be kept to a minimum.

**What can I do to help?**
Whether directly or indirectly interacting with the reef, there are steps everyone can do to help improve the overall health of the reefs. Beach clean ups, recycling and minimizing near shore water pollution can improve the reef, making it more resilient to disease. Divers, fishermen and boat users should review the best practices section to learn how to minimize their impact and likelihood of spreading the disease.

**If I suspect I have found an infected coral colony, what should I do?**
If you suspect you have encountered an infected coral you should take photos and share them with your local nature conservation organization or marine park management authority. You can also submit an official report on the AGGRA website. The more information you can include concerning the location, date, depth, species and surrounding reef the more likely a response team will be able to locate the coral again in the future. The best way to report the sighting is to include a photo of the infected coral to allow experts to properly ID and diagnose.
Appendix 1:
MPAConnect - SCTLD Divers Best Practices Poster

ALERTING ALL DIVERS!
An unprecedented disease is threatening corals in the Caribbean

It attacks stony corals and scientists are calling it ‘Stony Coral Tissue Loss Disease’
The coral disease is water-borne and may spread through contact.
The situation is urgent but corals are resilient if given the chance and the right conditions for their growth and survival –
let’s help protect the ocean.

Help stop the spread

Never touch corals! Have good buoyancy
Rent gear locally so you don’t spread the disease
Dive on healthy reefs before diving infected reefs

Decontaminate your gear

DIVE
AIR DRY
SOAK 1% Bleach Solution 10 mins
RINSE
DISPOSAL leave wash solution in sun for 1 day to break down then dispose

Pathogens can survive on dive and snorkel gear. Dive and snorkel gear can transfer disease among reefs and internationally.

Where is the disease occurring?

Stony Coral Tissue Loss Disease Management Letter for the Dutch Caribbean
Appendix 2:
MPAConnect - SCTLD Identification for Divers Poster

ALERTING ALL DIVERS!
An unprecedented disease is threatening corals in the Caribbean

It attacks stony corals and scientists are calling it ‘Stony Coral Tissue Loss Disease’

The coral disease is water-borne and may spread through contact. The situation is urgent but corals are resilient if given the chance and the right conditions for their growth and survival – let’s help protect the ocean.

Some disease is normal on reefs, affecting 2-3% of corals

Bare skeleton with no tissue
Slaughtering away of tissue
DEAD STONY CORAL

SICK STONY CORAL
HEALTHY STONY CORAL (SUSCEPTIBLE)

Other coral diseases, coral bleaching and fish bites can look like stony coral tissue loss disease.
What makes it different are types of corals affected and the pattern of spread.

Take photos

Note the dive site, coral location and date

Share the information via www.agrra.org/coral-disease-outbreak

A partnership between:

MORE INFORMATION
Scientists are working to identify causes and to develop treatments. Your local coral reef managers are in touch with these efforts and benefiting from the latest knowledge about the disease. For more information, see http://www.agrra.org/

Stony Coral Tissue Loss Disease Management Letter for the Dutch Caribbean
Appendix 3:

MPAConnect – SCTLD Identification Guide for Managers

Stony Coral Tissue Loss Disease Management Letter for the Dutch Caribbean

Total loss of affected tissue

Highly susceptible species

Rapid spread
Within one week to two months

High prevalence and mortality
Among susceptible species

What can managers do?

Be Alert!
A new coral disease is causing high mortality of stony corals

Cause is unknown but it is water-borne and may spread via direct contact

Take care not to confuse with other coral diseases, bleaching or fish bites

Correct field diagnosis depends on multiple factors

MPAConnect guide to detect
Stony Coral Tissue Loss Disease on Caribbean coral reefs

Bare skeleton with no tissue
Sloughing away of tissue

Pseudodiploria strigosa

Highly susceptible species

On coral colonies
Multiple lesions
Rapid mortality

On dive sites
Rapid spread among corals

Monitor highly susceptible species via roving diver surveys

Monitor sentinel sites weekly – old, large, healthy, spawning colonies

Inform your agency about new threat, seek contingency support, investigate supplies for treatment

Inform relevant stakeholders, encourage reporting

Prevent spread – wash dive gear in lots of fresh water and sun dry, disinfect survey tools, dive on clean sites before infected sites

Seek training in protocols for treatment of priority corals

Promote ballast water management, exchange ballast offshore and not on coral reefs

Contact MPAConnect for advice and training mpaconnect@gcfi.org

For more information, see https://floridakeys.noaa.gov/coral-disease/ and https://www.gcfi.org/emerging-issues-florida-coral-disease-outbreak/

February 2019

Coral photography: K. Neely, Nova Southeastern University
Graphic Design: ©2019 Deviate Design
Appendix 4:
MPAConnect – Protocol for Monitoring SCTLD outbreaks

The following protocols and datasheets have been provided directly from MPAConnect: Stony Coral Tissue Loss Disease Template Monitoring and Response Action Plan for Caribbean Marine Natural Resource Managers. (Doyle & O’Sullivan, 2019).

Objective: Identify Early Signs of the Disease

The recommended approach to determine the prevalence of the disease among susceptible species is Roving Diver surveys. A diver will conduct a census swim of the site, focusing on species that are primarily impacted by this disease outbreak. Multiple divers can conduct the survey at one site, but should partition the site amongst themselves, either vertically by depth and/or horizontally in opposite directions from a common starting point, or in parallel rows (as on narrow reef lobes). Their data should be entered separately.

1. Swim around the site (no greater than 50 m from the recorded coordinates) for at least 10 minutes or longer for a more complete sample size.

2. On the datasheet (Rover Diver Sheet, Table 2), record the following metadata:
   a. Name
   b. Date
   c. Site Name
   d. Latitude and Longitude in Decimal Degrees
   e. Time start and Time end of roving diver swim (10 minutes minimum, but longer is fine)
   f. Depth interval of survey.
   g. Habitat surveyed.

3. Record the species code of stony coral species seen on the swim. Exclude Milleporids, Acroporids, and Porites astreoides (PAST). Focus on colonies greater than 4 cm. For each species, tally the number of colonies exhibiting each of the following conditions:
   a. Newly dead colonies (bright white skeleton, polyp structure intact) Colonies with obvious other causes of mortality (breakage, toppling) should be excluded.
   b. Actively diseased colonies. Colonies with any level of SCTLD disease should be included here.
   c. Undiseased colonies with signs. i.e., colonies that do NOT have any active mortality due to SCTLD, but are showing unusual pale spots or focal bleaching. Colonies with dark spot disease should also be included here. (In meta-analyses, these colonies will be lumped in with “non-diseased” colonies.)
   d. Healthy colonies. No active disease or unusual signs.

4. Photos can be taken of unusual or interesting disease sightings
Table 2: Rover Diver Sheet

<table>
<thead>
<tr>
<th>Species Code</th>
<th>Tally colonies w/ recent mortality (likely due to disease)</th>
<th>Tally actively diseased colonies</th>
<th>Tally unbleached colonies w/ symptoms of concern (pale spots or local bleaching)</th>
<th>Tally undiseased colonies</th>
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Objective: Document the Progression of the Disease

Once SCTLD has been identified from roving diver surveys, its progression can be tracked by identifying priority coral reef sites and priority corals for monitoring using time-series photography and/or videography.

The following guiding principles can be used to help select priority sentinel coral reef sites, tailored according to the local reef area and diversity of reef types (barrier, fringing, atolls, faros, pinnacles, patches):

- Reef types affected by SCTLD: aim for representatives of each type as constituent corals are locally adapted to different environments with respect to wave exposure, sediment stressors and ambient illumination.
- Coral diversity: a diverse community may provide more opportunity to protect an intact ecosystem and preserve reproductive capacity of many species with less effort (the loss of particular species is less likely to disrupt the ability of the entire ecosystem to function).
- Coral density: a high density of corals may provide greater habitat complexity, more ecosystem services to other organisms and experience higher reproductive potential. However, crowded sites may also be more susceptible to infectious diseases, especially if many corals are clone mates and equally susceptible to the particular pathogen involved.
- Coral composition: sites that contain a high number of desired colonies of particular species (see below) may be prioritized.
- Coral demographic structure: Sites with large, reproductively active, framework structure-producing corals contribute disproportionately to habitat and propagation. These sites are often high-relief spur-and-groove reefs or large patch reefs.
- Isolation: Sites isolated by sand or hard bottoms lacking many live corals may be less susceptible to ongoing or high infection rates from water-borne pathogens. Discrete sites are easier to scout/search and may be able to be treated more effectively.

The following guiding principles can serve to identify priority sentinel corals for monitoring:

- Structure builder: Some susceptible species contribute substantially to reef-building and the associated ecosystem services that provide (especially Orbicella spp., Montastraea cavernosa, Colpophyllia natans). These species may be prioritized over others that are not primary framework builders.
- Size: Larger colonies are likely to have greater reproductive capacity and provide more habitat. Corals of species that grow larger than 2 meters may be prioritized for these features.
- Relative size: Colonies that are large for their species are likely to be older and thus more resilient to long-term environmental conditions. They also likely contribute more substantially to reproduction than their smaller conspecifics. Corals in the top 5% of size for their species may be prioritized.
- Localized reproductive capacity: A coral surrounded (in the same general reef area) by other live colonies of the same species probably has greater reproductive potential than a more isolated coral because its fertilization rates are likely to be greater.
Regulatory factors to include in the selection of priority coral reef sites and priority sentinel corals for monitoring include:

- Iconic coral: Corals identified by stakeholders as important for historical, educational, or economic reasons. This could include colonies popular at dive sites.
- Within an MPA: Corals within zones of extra protection may be living under better environmental conditions.
- Within a recreational area: Corals near mooring balls are likely to have more visitors who utilize the resource. This could provide additional awareness of treatment action and potentially greater involvement through citizen engagement. (Alternatively, if recreational diving is large-scale and unsupervised, they are more likely to perish than corals in other areas.)

Once the priority coral reef sites and priority sentinel corals have been identified for monitoring, it is suggested that the following monitoring methodology from Florida be adapted to suit site needs (Neely, 2018).

Objective: Quantify the Spatial Extent of the SCTLD Outbreak

In areas where SCTLD is known to be present and any treatments are being implemented, especially if in MPAs, then experienced coral surveyors should be encouraged to conduct at least six, non-fixed AGRRA-coral transects/site to quantify the extent of the disease in spatially-defined transects. These surveys should be repeated at six-monthly intervals to provide periodic assessments of the success of the interventions.

Complete AGRRA-type surveys at long term monitoring sites affected and unaffected by SCTLD can also be used to determine impacts of the disease on coral reef ecosystems including fish populations.
Per Neely, 2018, the protocol for preparing and applying antibiotics is as follows:

1. Mix powdered amoxycillin into the base in a 1:8 by weight ratio on the same day as it is being used in a glass beaker or other small container. The total amount prepared depends on how many corals can realistically be treated during the day in question. Pack the mixture into 30cc or 60cc syringes.

2. In a dive bag pack rubber gloves, antibiotic syringes and modelling clay. Use the syringe to cover the lesion and the immediate area surrounding the lesion. Use your fingers to apply the compound to ensure that it adheres to the lesion (Figure 6) (Neely, 2018).

3. Modelling clay can then be applied over the paste to increase adhesion to the coral (Doyle & O’Sullivan, 2019).

4. Alternative or additional intervention can be accomplished by creating and treating a firebreak approximately 5 cm away from the disease margin (Neely, 2018).

If CoreRx Base2B is being used then mix with amoxycillin powder just prior to application, otherwise the antibiotic will become ineffective after a few days. Dr. Andy Bruckner of Florida Keys National Marine Sanctuary, suggested that in the absence of CoreRx Base2B, managers apply whatever locally available, cheaper material they may have from the lesion interface over the live tissues as well, in anticipation that this measure will kill the pathogen(s).
References


