Marine Damage Report
&
Dive Sector Needs Assessment
Commonwealth of Dominica,
Post Hurricane Maria

Funded by OAS

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Needs Assessment for Commonwealth of Dominica Following Hurricane Maria

Introduction

The Commonwealth of Dominica is known for experiencing extreme weather conditions and earthquakes. The island lies within the hurricane belt and has been impacted by many hurricanes and tropical storms. The most damaging storms in recent years include Hurricane David in 1979, Hurricane Hugo in 1989, Hurricane Marilyn in 1995, Hurricane Lenny in 1999, and Tropical Storm Erika in 2015.[2] On August 27, 2015, Tropical Storm Erika hit Dominica. Rainfall of approximately 38 centimeters was recorded in southern Dominica, but because of the peaked topography of the island, it is likely that even higher levels of rainfall occurred in the interior of Dominica due to Tropical Storm Erika. The large amount of rainfall over such a short period caused landslides and flash-floods which resulted in carnage throughout much of the country—the most severe of which was reported on the western and south-eastern coasts. Tragically, 31 people died as a result of the storm and many more were displaced or experienced property loss or damage. The total estimated damage from T.S. Erika in Dominica alone was $483 million USD. The extensive impact of Tropical Storm Erika on Dominica emphasized the significance of hazard preparedness and climate change risk management, particularly at the government level.[2]

Most recently, Hurricane Maria (Figure 1) struck Dominica the evening of September 18, 2017 and bisected the island from southeast to northwest (Figure 2) during a period of about 8 hours with sustained wind speeds of 160 miles per hour (mph) and wind gusts well in excess of 250 mph (Figure 3).

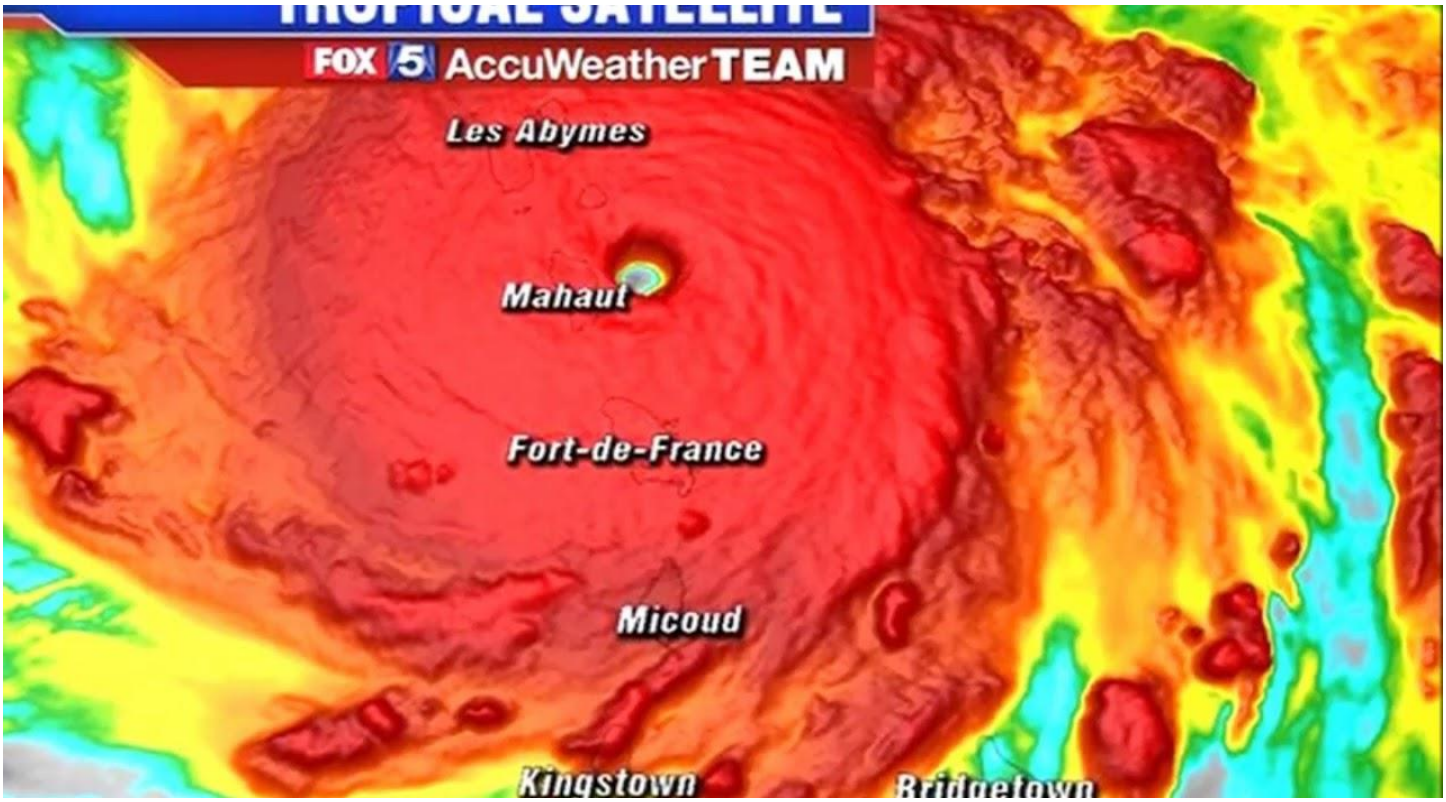


Figure 1. Hurricane Mara after making landfall on the Commonwealth of Dominica.

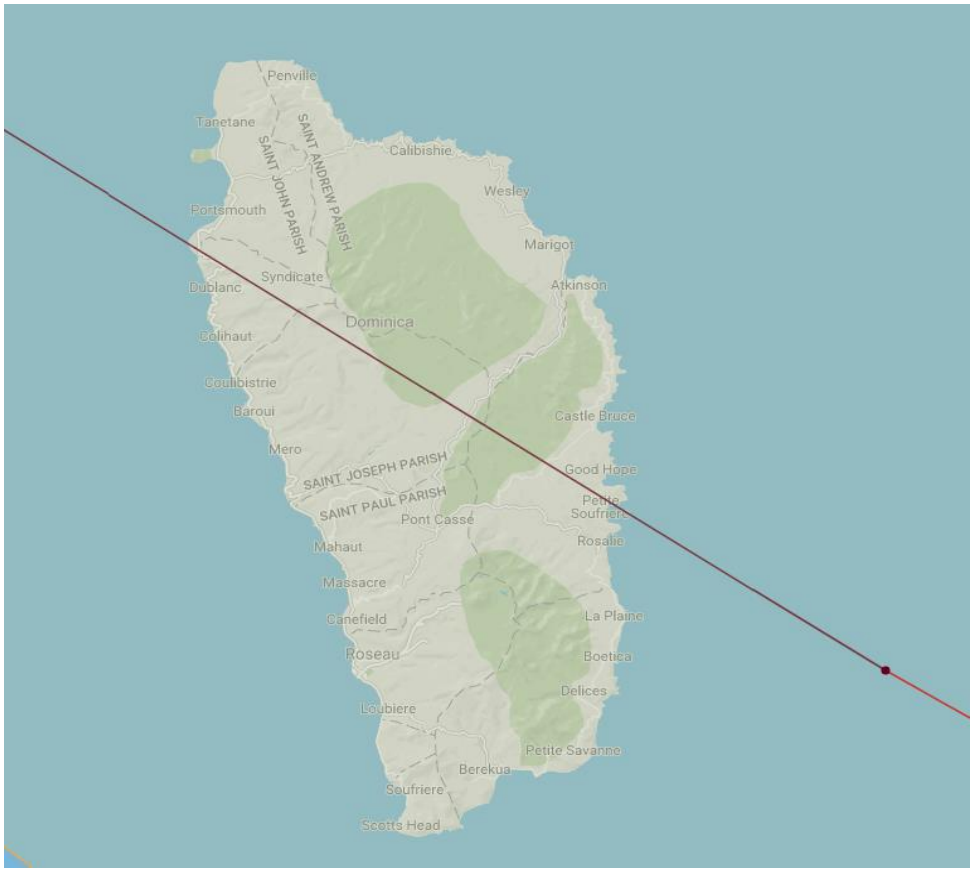


Figure 2. Hurricane Maria's path over Dominica.

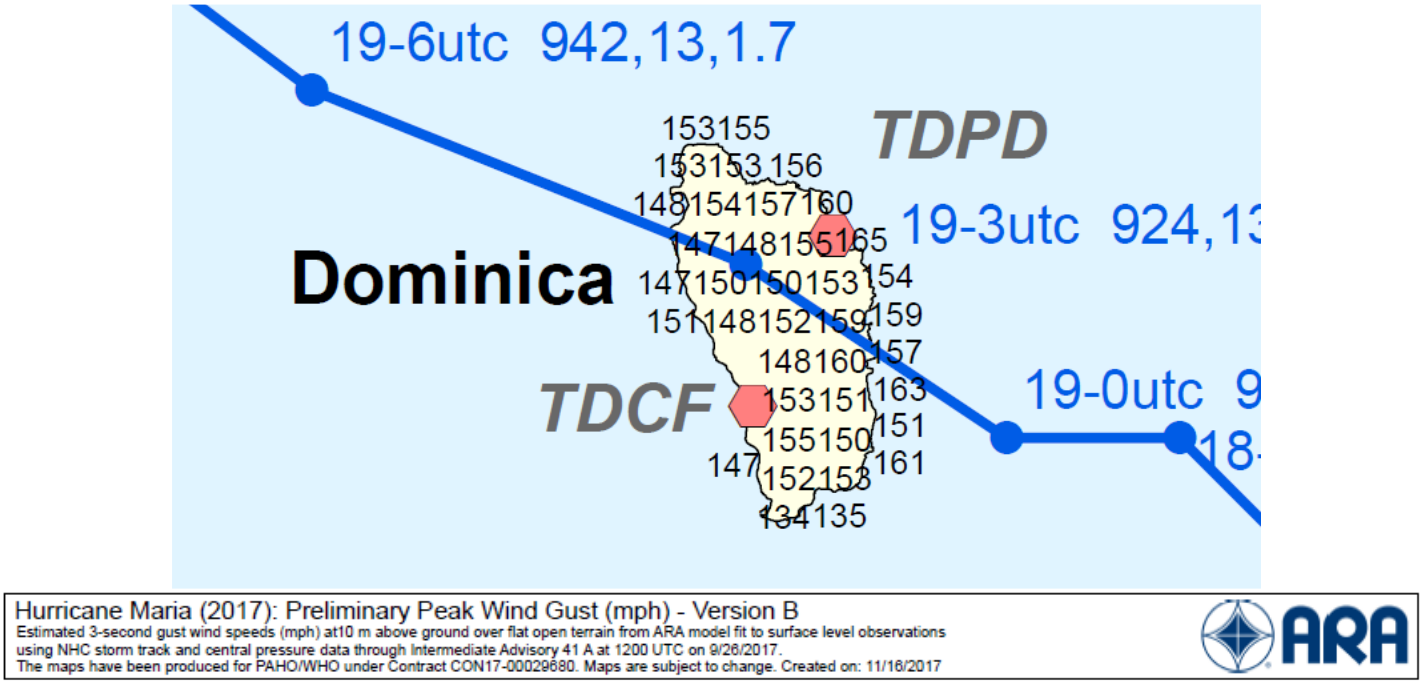


Figure 3. Preliminary 3-second wind measurements in mph at 10 meters above ground taken by weather stations which failed during Hurricane Maria.

Due to high wind speeds, terrestrial destruction was extensive in both areas of forestation and human habitation.[1] After battering the island for hours, the hurricane moved away from Dominica and through the region to the northwest (Figure 4). Effects from the passage of this hurricane will likely be felt for decades in Dominica and its surrounding region.

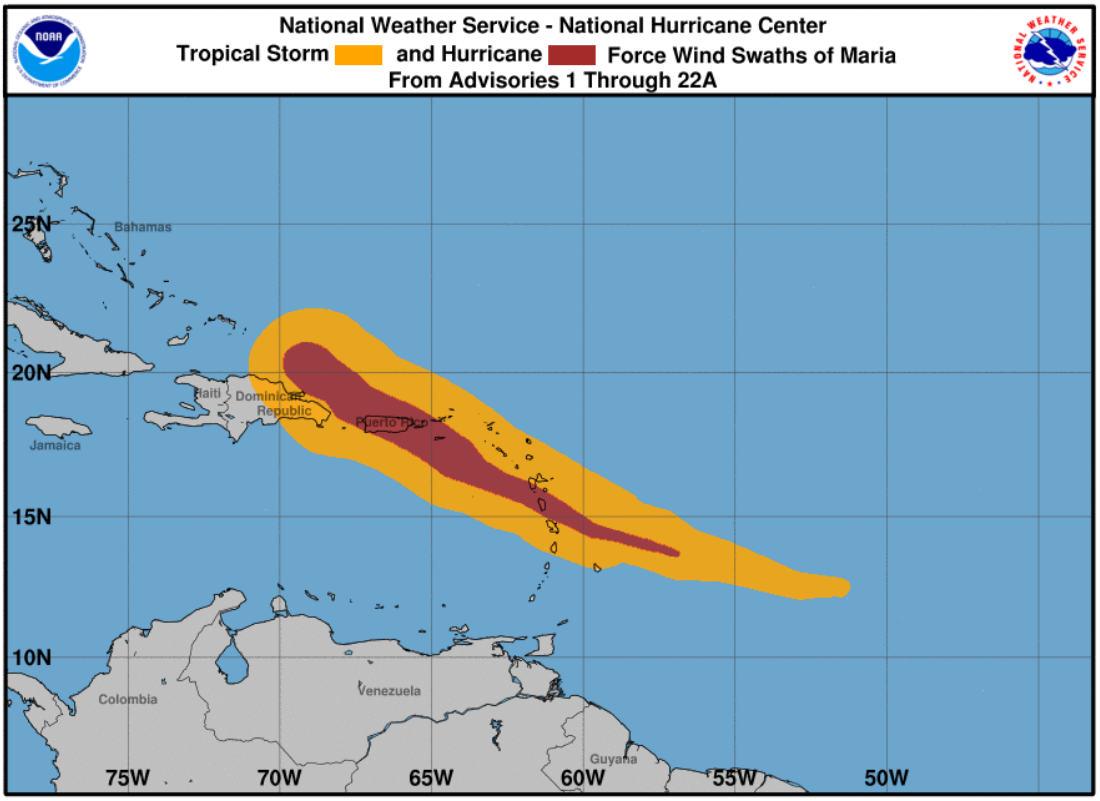


Figure 4. Passage of Maria through the region

Tourism

Dominica is a country pursuing economic growth and increased quality of life through reducing poverty levels. The public sector is a major component of the economy contributing to 20% of the gross domestic product (GDP) in 2009 and 2010.[2] There is a strong focus on developing Dominica's tourism product, increasing agricultural production, keeping agricultural product local, as well as attracting private investment by taking on an entrepreneurial approach to support public-private arrangements. Dominica's existing socio-economic conditions demonstrate a need to grow the economy and develop climate-focused, sustainable communities.

Tourism is a priority sector for Dominica, and makes up approximately 16% of Dominica's GDP. The Tourism Master Plan 2012-2022 forecasts an increase to 23% of the GDP by 2022. Tourism activity on the island consists of cruise lines and yacht operations, natural tourist attractions (waterfalls, parks, scuba diving, and whale watching) and several hotels. In 2012, Dominica hosted approximately 79,000 stayover visitors, 266,200 cruise visitors, 11,760 yacht visitors, and 1,500 excursionists (day trips from neighboring islands).[2] Stayover visitors continue however to bring more tourist dollars to the islands economy than Cruise.

In promoting our scuba diving product we often state that we have three distinct types of diving here off Dominica. Our reefs are relatively young, as Dominica is the youngest island in the Caribbean island chain. The reefs consist of a rock base upon which coral and sponges have taken hold. Unlike many other islands, Dominica's reefs are predominantly sponge-dominated (Figure 5).

Figure 5. Diver on a post-hurricane sponge-dominated wall.

In the north, fringing reefs lead to reef slopes which extend from shore and gradually drop into deep water, the angle of the slope gets steeper as the depth increases. These reefs are known for their impressive elephant ear and iridescent vase sponges as the vibrant colours seem to pop (Figure 6).

*Figure 6***.** Generic, untouched post-hurricane reef scene with vibrant sponges.

The Cabrits Marine Reserve was created as an addition to the national park of the same name and is currently managed by community stakeholders and the Portsmouth Area Yacht Services (PAYS) who maintain the moorings when materials are available.

The central region has the only dive-able continental shelf which extends about a kilometer out from shore. The continental shelf is very gently sloping and consists of predominantly soft corals, sea rods, plumes and sea-fans. The shelf edge drops steeply into deep water where the corals change from soft to hard and then to sea whips and sponges as depth increases. Being a shelf extending seaward, the passing currents have enabled the soft coral communities to flourish. This area also has the only true spur and groove (finger reef) along our coastline.

The south is made up of a volcanic crater formed 30,000 years ago in one of the most explosive eruptions in the region in the last 200,000 years. The reef in the south is more dramatic with its plunging walls and very

little reef shelf. Most sites are around the rim of the submerged crater and “wall diving” is the norm (Figure 7). Along the shoreline are numerous volcanic vents where hot water or gas seeps upwards and may be seen or felt as the heat rises. Hard and boulder corals dominate the reef-top in this area, whilst plate corals give way to whip corals as the depth increases. Sponges, of course, are found from the top of the water column to the depths below as filter feeders can thrive in most places.

Figure 7. Diver on a dramatic wall.

Threats

Siltation is by far the biggest threat to the reefs mentioned above.Sponges, being filter feeders, choke to death slowly on silt. Corals, also being filter feeders, get covered in too much silt and cannot feed to survive. Pollution and overfishing are also large threats to the reefs of Dominica. Overfishing on the reefs is being addressed by the Fisheries Division of The Ministry of Agriculture and Environment, but pollution and illegal dumping, being more widespread and harder to pinpoint, is mainly ignored. Though the threats above may make it appear so, especially with Dominica being the ecotourism capital of the region, it is not all bad news. Grassroots education is happening and it will take time, but people are becoming more environmentally aware and are, more importantly, teaching their children what they know about responsible stewardship of the island. Recently, less garbage has been tossed into the streets and along roadsides. There are also several stores selling viable biodegradable replacements to Styrofoam—but old habits die hard.

Despite this, Dominica hopes to become the first country in the region to completely ban Styrofoam products in favor of biodegradable replacements. Hopefully, one day, plastic bags and thick plastic bottles of types PETE, HDPE, LDPE, which are the scourge of almost every Caribbean nation, will be a thing of the past too.

West coast marine damage assessment

Damage to marine resources due to hurricanes can occur through:

1. Wind and wave erosion of mangrove forests which inhibits buffering of incoming storms
2. Introduction of terrestrial debris (trees, silt, cars, roofing, etc.) into waterways and onto coral reefs which breaks sections of reef and disrupts or stops photosynthesis and filter feeding
3. Generation of reef debris (coral heads, seagrass beds, etc.) which is dislodged from the reef by wave energy, gathers in the water column and along the bottom of the shelf and smashes back into the remaining reef
4. Abrasion of corals by sand which was forced into the water column by the storm

Dominica's reefs are sponge-dominated and known internationally for their vibrant color and the relatively abundant macro-life. Corals form a slow-growing secondary cover. Sponges, in contrast, are fast-growing, and, at the time of writing, smaller sponges, especially the yellow tube species (*Aplysinia fistularis*), are already re-growing from scars created by Hurricane Maria (Figure 8).

Figure 8. Sponge growth since September 2017.

Given funding limitations, the following were dived and surveyed either personally through funding from OAS/Reefix or with the ReefCheck team:

- A total of 9 sites in the North at Cabrits National Park
- A total of 7 sites in the Mero-Grande Savanne area (proposed MPA)
- A total of 9 sites (so far) in the SSMR

On average, the overall damage has been described by the ReefCheck survey team as Level 1-2 with (20%-40%) of the reef damaged primarily on the reef flat in shallow water at depths of 12m (40ft) and shallower. The deep reef, for the most part, remained intact. This is an extremely low damage assessment compared to other island impacted by the storm. The deep water spared many of the reefs, absorbing the full impact of the waves driven by the storm. The main need is for mechanical infrastructure.

Dive site damage report

Sites dived in each location are listed and, if not specifically written about, one may assume that there is no damage, or that any damage present is superficial and fast-growing recovery was present.

North

Sites Dived:

- Secret Arch Reef
- Toucari Caves
- Tube Reef
- Douglas Bay Point
- Nadine/Canon site
- 5 Finger Rock
- Sharks Mouth
- Sunshine Reef
- Pole to Pole

- **Pole to Pole [under the pier at Cabrits terminal]:** Shows some sign of damage, however, much of the growth under the pier was growing on garbage and discarded fishing line. This has all been removed. All debris from the pier itself has been sent into deeper water and was not found. Inshore there was a rock and coral field, this has been removed by wave action, much of the coral is onshore. Most if the soft coral and sponge growth has been removed. A large stand of Boulder Star Coral (*M.annularis*) had been overturned and was not able to be righted by a lone diver.
- **Canon Site [towards 5 Finger rock]:** Has a tree trunk, a large piece of piling and a tire in it. The piling can remain as it is wood and will form the base for marine growth, but the tire has to be removed. Areas of club finger and finger coral have been damaged.
- **Toucari caves:** Club finger coral bed (*Porites porites*) on the western reef-top, has been destroyed, but is a rapidly growing coral. The largest barrel sponges (*X.muta*) in the shallows near the mooring (5m) have been removed, but base scars remain and will, in time, regrow.

Some other sites show removal of large barrel sponges in shallow water, but limited to no damage to reef-building corals.

Central

The reefs from the Grande Savanne area were most affected by Hurricane Erika and were just recovering. This area is not as heavily dived and dive staff have to contend with fishermen cutting moorings and no regulation regarding fishing activities. The area from St. Joseph to Coulibistrie has been nominated as a prospective MPA in the Government land use plan for 2016. A proposal for funding is being written for external funding review.

Sites Dived:

- Easy St.
- Lauro Reef
- Brain Coral Reef
- The Aquarium (first 100m)
- Nose Reef
- Whale Shark Reef
- Rina’s Reef
- Coral Gardens
- Maggie’s Point (Mero)

- Berry's Dream (Mero)
- Rodney's Rock (Jimmit)

- **Easy Street:** Very poor condition. Rains post-Erika created two rivers and several rain-fed waterfalls which drain directly onto the reef. Tree debris and silt have choked the reef. It is strongly recommended that an alternate site be found for diving.
- **Lauro Reef:** Reef flat soft corals and some sponges remain. The gullies and overhangs are filled with debris and branches. The finger coral bed has been destroyed. Surprisingly, the soft coral growth on the reef flat, although damaged, has remained.
- **Maggie's** point (Mero): Once the most extant and healthy thin finger coral reef (*Porites divaricata*) along the west coast, has been extensively damaged. Some gullies filled with debris and the outer deep reef also shows damage from tree and debris.

South

Dive sites in the south are more popular with visitors and visually more dramatic to the other geographic regions. They are clustered within the Soufriere Scotts Head Marine Reserve and much has been written on this area and is available online. A submerged volcanic chute of over a metric mile charted depth is in the South. The Marine Reserve was the first Local Area Management Association in the region and was designated and opened in 1997.

Sites dived:

- Coral Gardens
- Dangleben's Pinnacles
- Soufriere Pinnacles to Labym
- Labym/La Sorcere
- LaBym central
- Labym North
- Tous Sable
- Scotts Head drop-off
- Inshore at Suburbs (adjacent to the first landslide)
- Scotts Head Pinnacles
- Pointe Guignard
- Inshore at Suburbs

- **Champagne:** A key site for Dominica and known regionally, arguably the most popular snorkel site along the coast. Reef-top (< 3m) has been cleaned of coral and sponge growth. Elkhorn coral (*Acropora palmata*) which had been cultivated on the reef-top since 1995 has been removed. The reef wall to 15m has been damaged with many large sponges removed. However, the reef flat in 18m (60ft) and deeper remains intact. Sponge life is growing back already. Due to landslides and erosion along the Soufriere road, the access to this beach needs to be assessed and fixed before the start of the new tourist season.
- **Coral Gardens:** Extensively damaged. Trees, rocks and silt from the landslide at Dangleben's have choked the reef (Figure 9). The staghorn coral bed (*Acropora cervicornis*) cultivated by all dive shops since 1995 has been destroyed by silt and debris.
- **Tous Sable:** The east side area over the cave was surveyed by the Reefcheck team. The reef-top has been cleaned of growth leaving a boulder and broken coral field. The boulder star coral mounds (*Montastrea sp.)* and plate forms of the same corals on top of the cave have been overturned and are in deeper water. The saddle between east and west halves was relatively unscathed. Tous Sable's west side, was relatively undamaged due to shelter by the headland.

- **Soufriere Pinnacles to LaBym:** a vertical wall of a metric mile depth (1600m), is now cleaned of all growth by wave action.
- **Pointe Guignard:** At the base of one landslide and close to another, (Figure 9) the inshore section of this site, once called tube sponge plateaus has been devastated by debris. The slope to the reef is also covered in silt and the reef adjacent to the point has sustained damage. The wall along the promontory is intact with a little sponge damage, all reef along the wall is intact. However, the cave has siltation and the reef slope beyond the cave is damaged.

In all areas where there has been limited or superficial damage the macro-life is proliferating. Space once occupied by large sponges and coral growth is now giving way to smaller life. Many shrimp and lobster have been seen, and, as previously mentioned, smaller faster-growing sponges are already shooting up.
The area inshore of Suburbs on the south coast was dived and showed no sign of damage at all, despite the landslides shown in (Figure 10).

Landslides within the Soufriere Scotts Head Marine Reserve (SSMR)

*Figure 9***.** Landslide at Pointe Guignard/Dangleben's.

Figure 10. Two landslides on the southern coast adjacent to dive sites represented by arrows, with the Suburbs circled in red.

Infrastructure

The Dominica Watersports Association (DWA) has traditionally maintained all dive moorings along the West coast as much as possible. In some areas, there is still a clash with certain (known) fishermen, but overall, moorings are kept in a reasonable working condition. A hydraulic drill capable of driving sand screws, Manta Rays and drilling holes for mooring pins was bought by the EU in 2006. The machinery was destroyed in the storm. Moorings in the north at Cabrits are maintained by PAYS (Portsmouth Area Yacht Association) and Fabian Honore of Aquaholic Dive at Purple Turtle Beach. Moorings in the Mero/Grande Savanne area have been primarily maintained by East Carib Dive and are all in need of replacement. Moorings in the SSMR are maintained by LAMA/CATS via user fee and project budgeting and are still lacking in many cases.

Mitigation

The biggest threat to the reefs is currently siltation. This is from landslides (3 within the boundary of the SSMR alone, not including the road at Champagne) and, most importantly, from removal and dumping of building materials and debris from the hurricane. Illegal private dumping over cliff edges is still a big issue which has been ongoing for decades and is now especially prevalent. Runoff from the forests will also become an issue as rainy/hurricane season returns and there are fewer trees to absorb the rains. Watershed management by Forestry/National Parks and the Environmental coordinating Unit will become much more crucial than ever.

As part of the climate change resilience proposed by government agencies, there should be a firm decision made to step away from concrete block moorings and to opt for more environmentally friendly methods.

Currently, the government needs to make good its commitment towards establishing the area from St Joseph to Coulibistrie as some form of MPA. This was laid out in the National Physical Development Plan dated November 2016.

Scuba mitigation measures

The DWA has already advertised several reef clean up dives for the month of July as part of the 2018 Dive Fest program. In the north, the large tire at canon site needs to be removed, as mentioned, as quickly as possible. In the central area, there are several alternate dive sites in use requiring mooring pins these will alleviate pressure on damaged areas and allow them to recover over time. There is a need for total adoption of no more concrete block moorings by all members and by agencies associated with the DWA. In the south, several new pins need to be drilled and at least two new alternate sites determined as safe second sites for divers. In the central area, at least four new dive pins need to be deployed to new dive sites being used, but not currently buoyed. These will need to be discussed between members of the DWA at meetings and recommendations reviewed by Fisheries Division before new pins are implemented.

Needs

Due to the impact that Maria had on the island, its tourism product, and the reefs, unless funding can be sourced, the provision of materials and installation will be difficult for several years at best. Given the scope of this survey and the needs outcome, it may be prudent to provide immediate assistance by purchasing and shipping materials to ensure all moorings are replaced with new ones as expeditiously as possible. Members of the DWA will cut, splice, create and deploy the moorings. As part of this request, 10 new mooring pins will be deployed in areas where one is needed, and in areas where a new site is deemed necessary to remove pressure on the existing critically damaged area.

To this end, a list of materials required is provided below. The prices are quoted from Budget Marine in Sint Maartin.

ITEM	QTY	ITEM DESCRIP.	Size	Unit cost USD
1.5 inch mooring line	5	Bales (600ft)	3000 linear feet	$2117
1 inch yellow float line	3	Bales (500 ft)	1500 linear feet	$445.00
White mooring ball	85		Includes spare	$141.00
Chafing hose		400ft		
Shackles	100	1.5 inch	Includes spare	$2.16
Sand screw	10	4 ft	Includes spare	$41.50
Mooring pins	20		Includes spare	
Hydraulic drill & compressor	1		Need to call	
100/60ft hydraulic hose	1		Need to call	
2 part marine epoxy	3	Case	Need to call	

The provision of chafing hose will eliminate the need for galvanized/stainless steel eyes as part of the mooring. In the case of the machinery, installation will be done by the consultant and a team of qualified divers

already trained in use of the drill and the manta/sand screw system. After deployment, the compressor and drill will be housed at Nature Island Dive in Soufriere for use coast-wide by members of the DWA and PAYS.

Recommendations

- Continued school and fisherman education programs which cover coral reefs and the benefits they have to the island.
- Legal action against illegal dumping along the coast. One highly publicized court case with sentence would serve as a deterrent to others.
- Removal of all ghost and non-buoyed fish traps coastwise on all dived and non-dived sites for the month of August.
- Locate and map alternate dive sites to remove pressure on those most affected by the storm.
- Find suitable sites for coral harvesting and site areas suitable for transplantation and propagation.
- Contact regional specialists regarding coral propagation/transplantation techniques, e.g. Buccoo Reef Tobago. Thin finger coral (*P. divaricata*) may be transplanted from Maggie's point and deep section of Coral Gardens/Dangleben's. Staghorn coral *(A.Cervicornis)* needs be found along the coast and a new coral bed reseeded. At Champagne, both Elkhorn *(A.palmata)* and Staghorn may be transplanted and reseeded on the reef-top.
- Locate (via proper channels) a decommissioned warship to be sunk off Rodney's Rock in 30m water as an attraction. (Reported to be a vehicle graveyard in the area too).
- Source funding for the proposed MPA from Mero to Coulibistrie.

One of the world's most published underwater photographers stated in his last visit that he, "always loves coming back to Dominica as we have the last blue water on healthy reefs in the region." Everywhere else he goes it's green with runoff from golf courses, pesticides and hotels. There is still hope, let's not kill it with sediment and idle talk.

Grateful thanks
Aquaholic Dive/PAYS, Purple Turtle Beach, Portsmouth
Francisca Bellot, Scuba Instructor, Dominica
Sophia Tellman, Coastal Carolina University, SC, Volunteer diver/Editing services
Simon Walsh, Scuba Instructor, Images Dominica
Nazarene Winston, Divemaster, Dominica
ReefCheck, initial survey
Brittany Holbrook, (Reefcheck) some imagery

Special mention

Cabrits Dive Centre, Picard, for doing clean up dives removing lots of galvanized roofing materials
Harald Zahn for maintaining the moorings in the Grande Savanne area with extremely limited materials.

Literature cited

Gibbs, T., FREng (2017) The Wind Speeds in selected Islands during Hurricanes Irma and Maria in 2017 (PAHO)

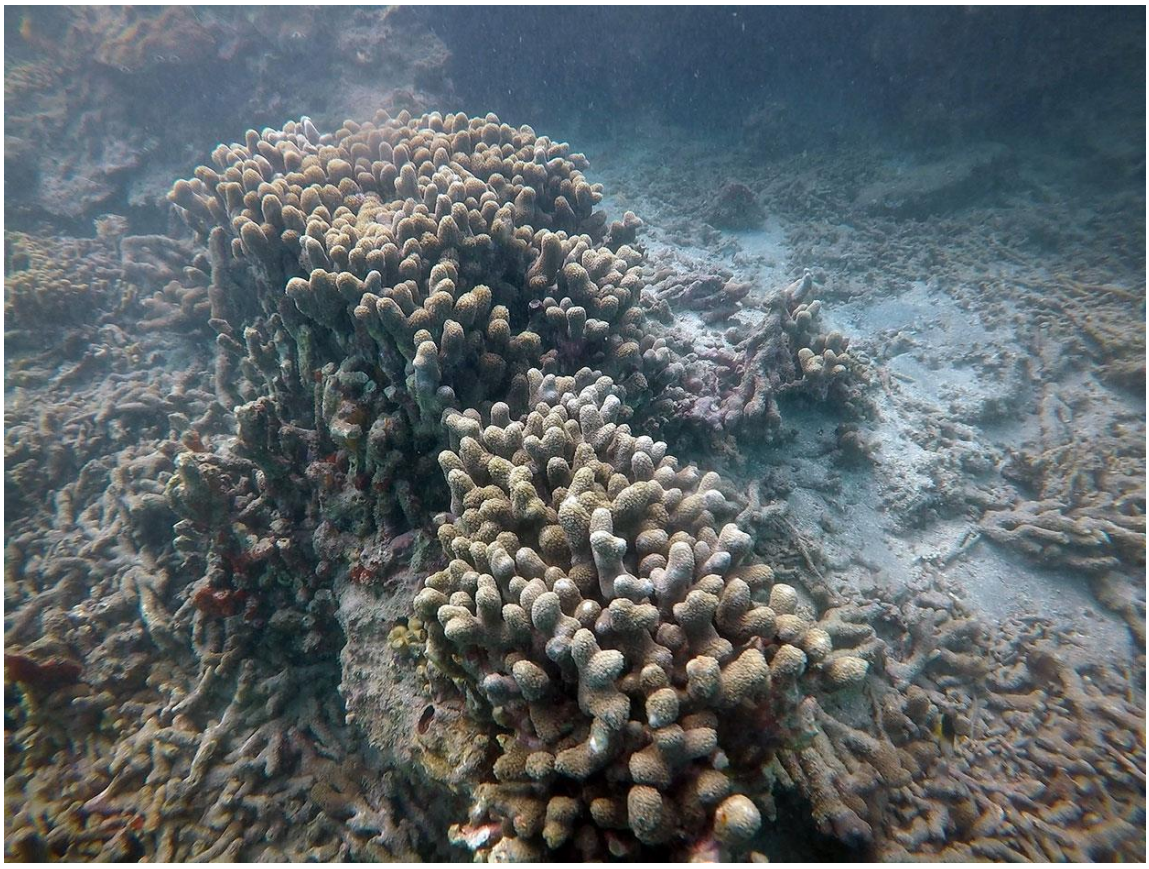
[1]Hodgson G., Madisetti, A. Hewlett, J. et al. (2018) Reefcheck Post-Hurricane Rapid Damage Assessment Dominica Coral Reefs and Reef Fisheries. Summary Report For Department of Fisheries January 22, 2018

[2] National Physical Development Plan November (2016), Dillon Consulting Limited, Ministry of Planning, Economic development & Investment, Commonwealth of Dominica.

National Weather Service, Hurricane Maria Imagery, NOAA September 19th 2017

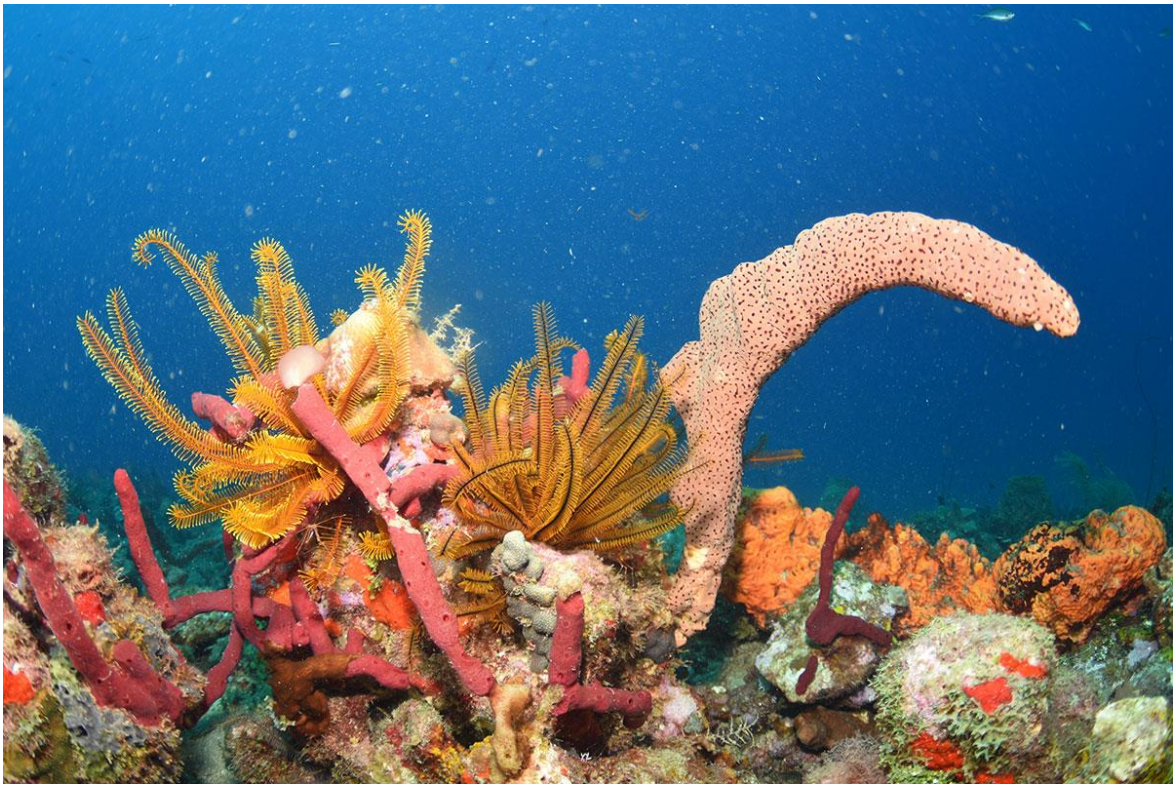
Post Hurricane Maria photos, credit by Images Dominica unless otherwise stated

Debris on canon site, Cabrits



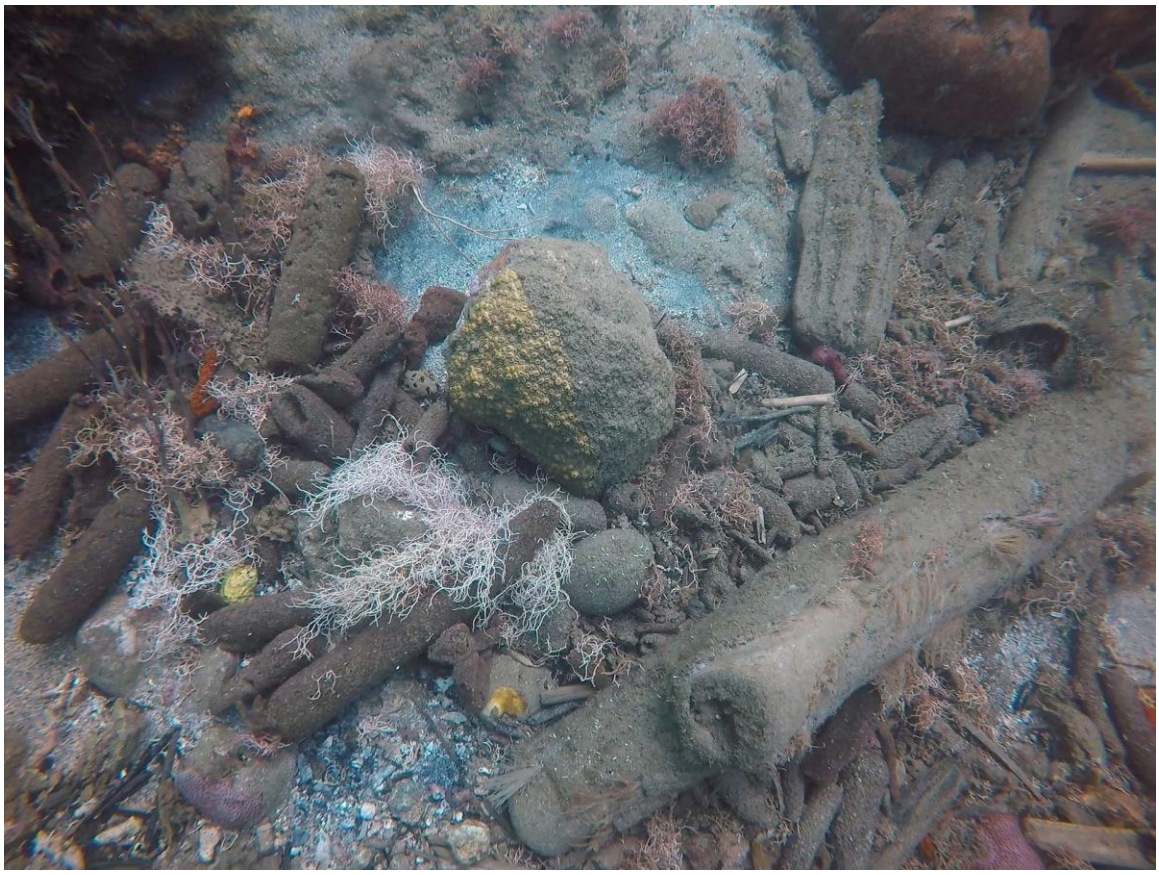
Damage to *Porites porites* at Canon site (B.Holbrook/ReefCheck)

Healthy reef, Douglas Bay point, Cabrits



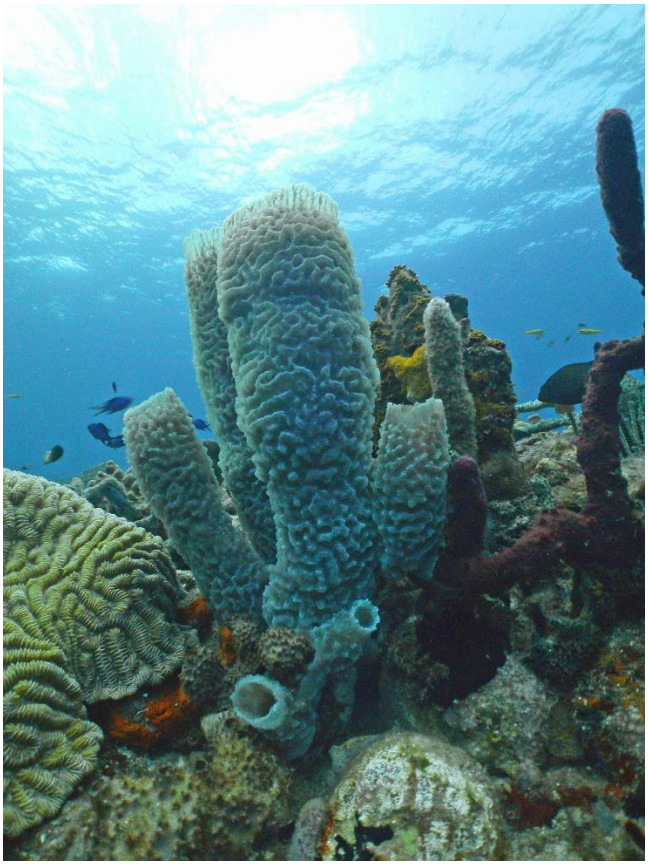
Tube reef, Cabrits

Undamaged shallow water reef (3m) at Secret Arch Reef, Cabrits

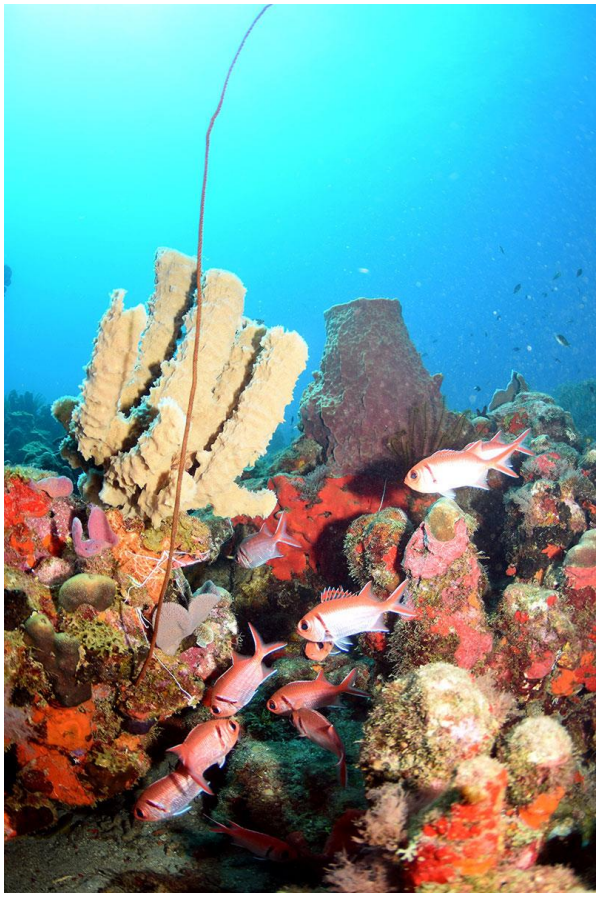


Lauro Reef (8m), Grande Savanne (B.Holbrook/ReefCheck)

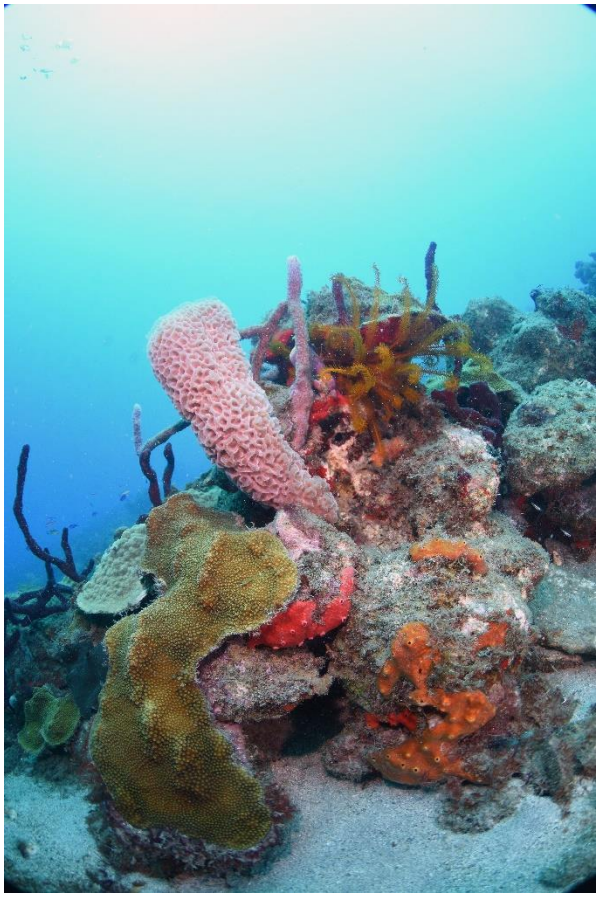
Undamaged Secret Arch Reef (6m), Cabrits



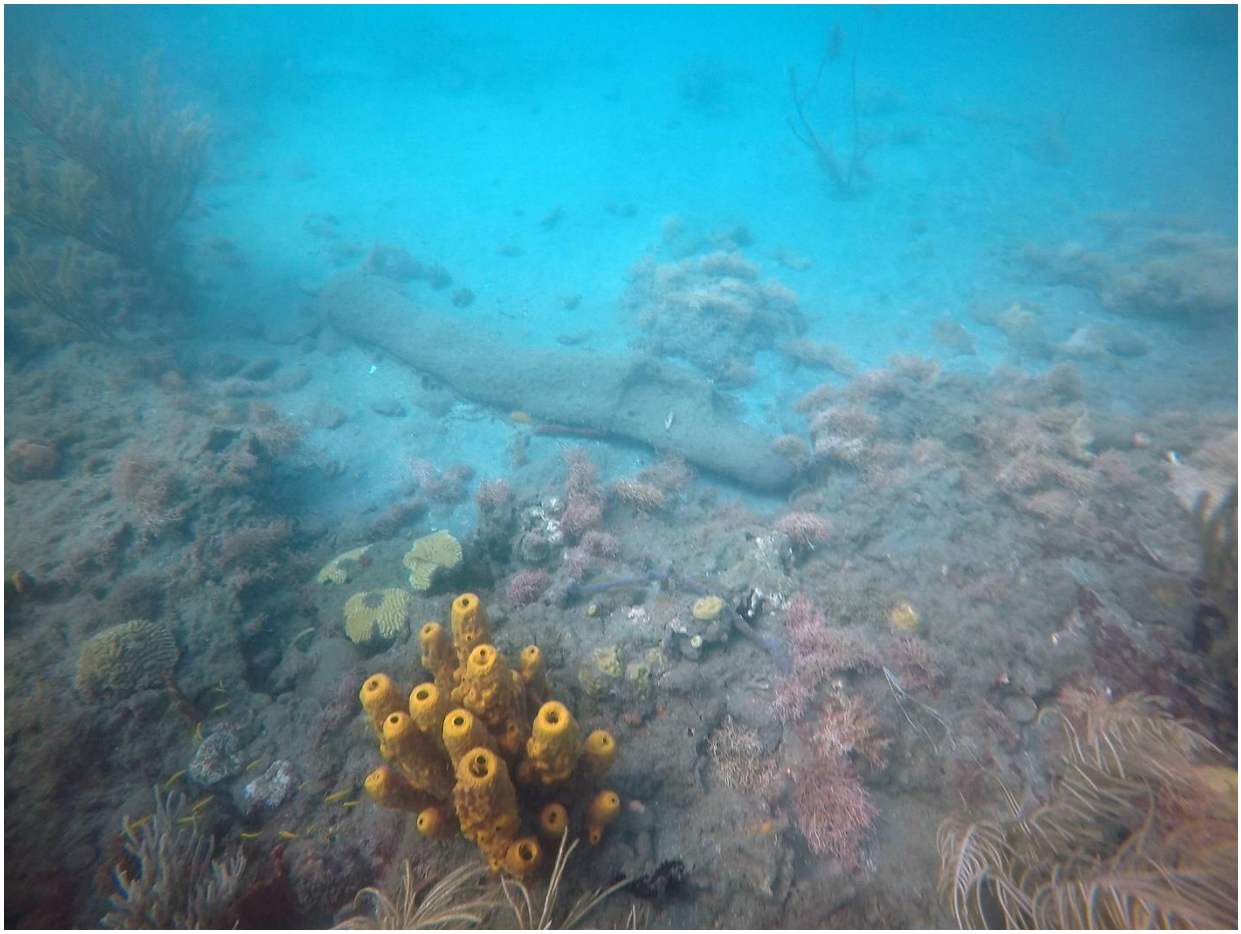
Healthy *Calispongia plicifera*, Sunshine reef, Cabrits



Tube Reef, Cabrits

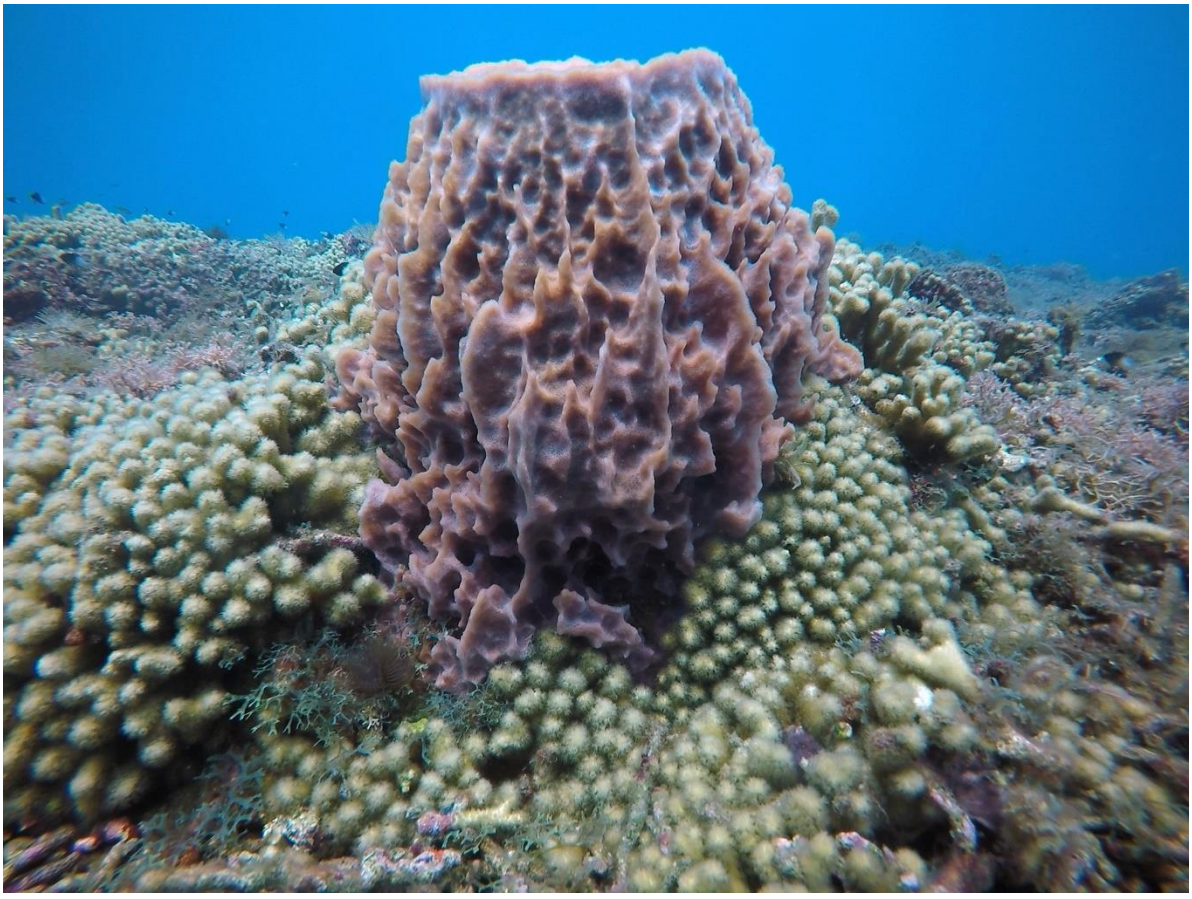


Sunshine Reef, Cabrits

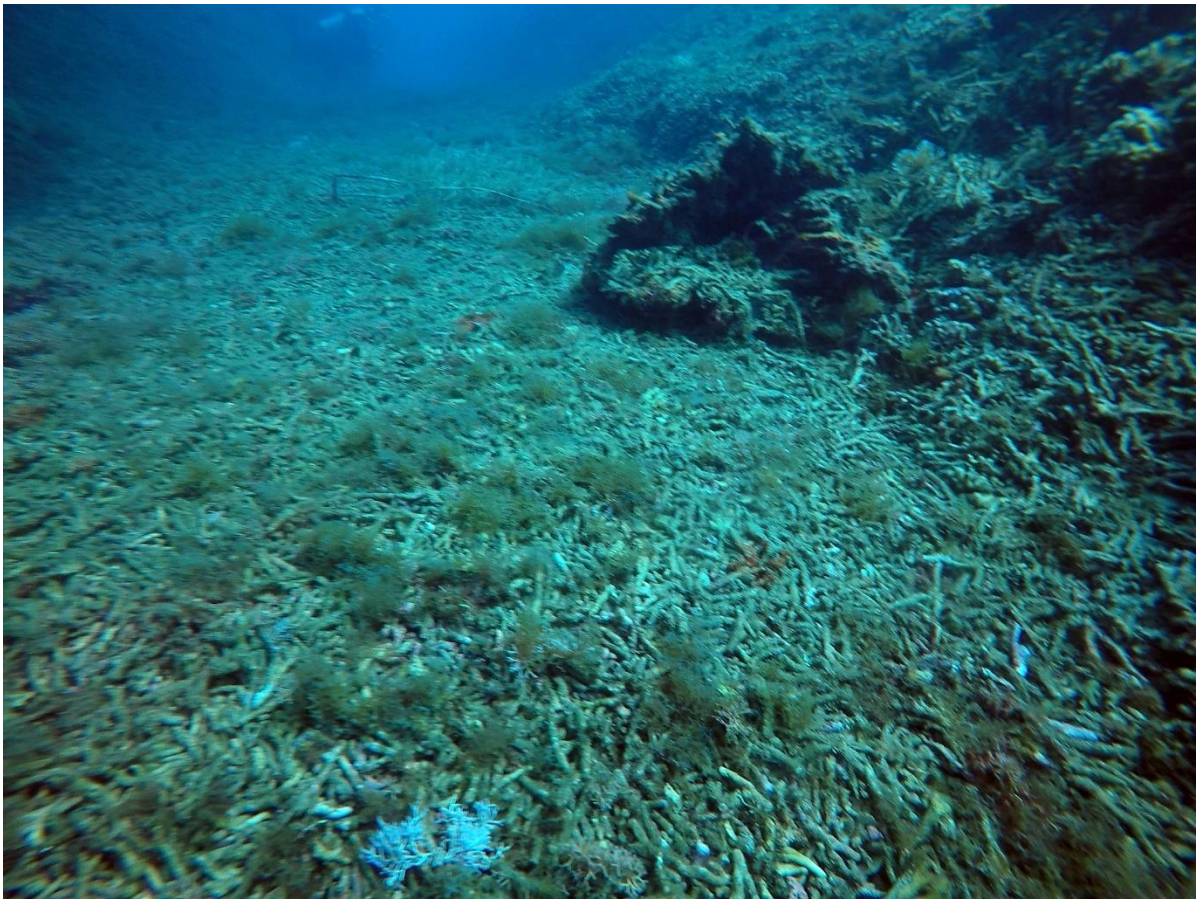


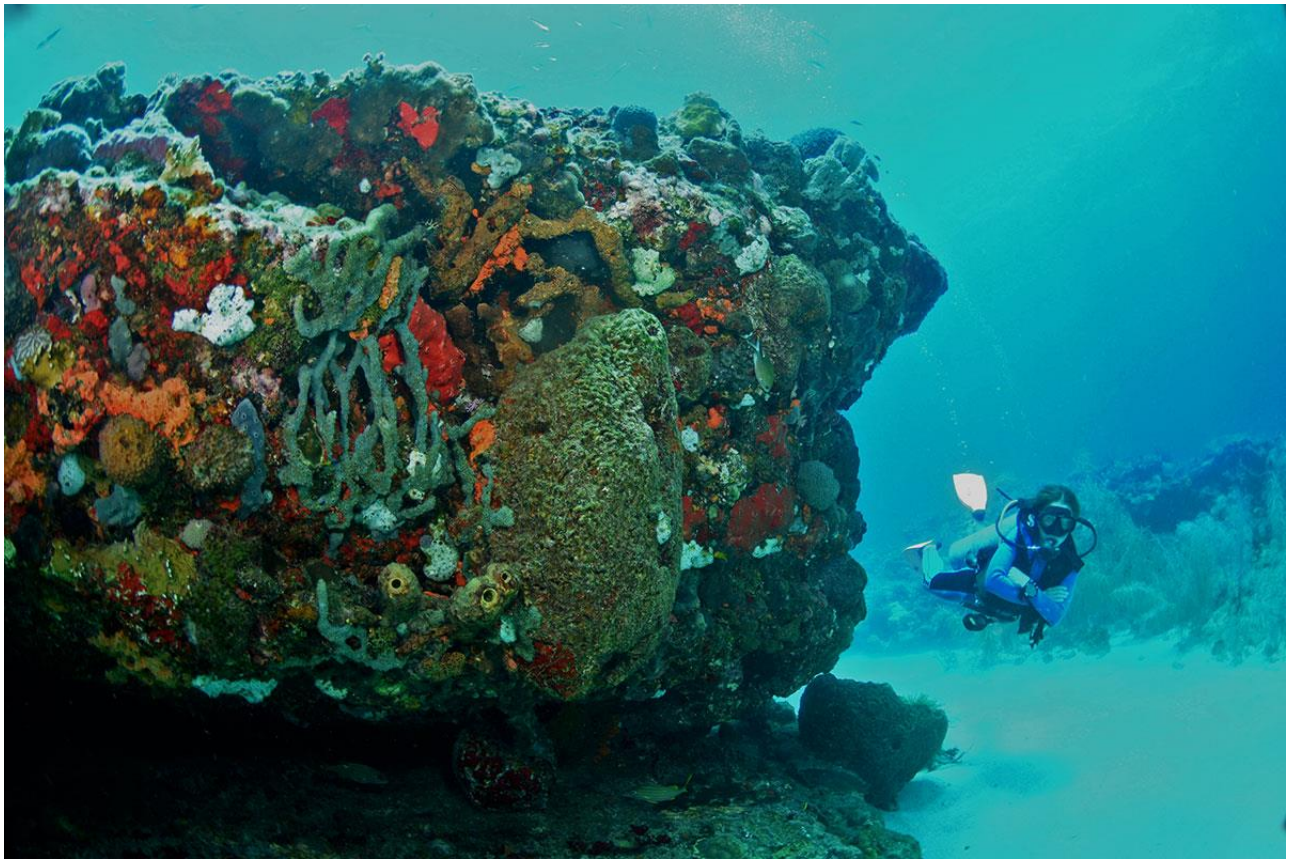
Lauro Reef (8m), Grande Savanne (B.Holbrook/ReefCheck)

Whale Shark Reef (15m), Grande Savanne

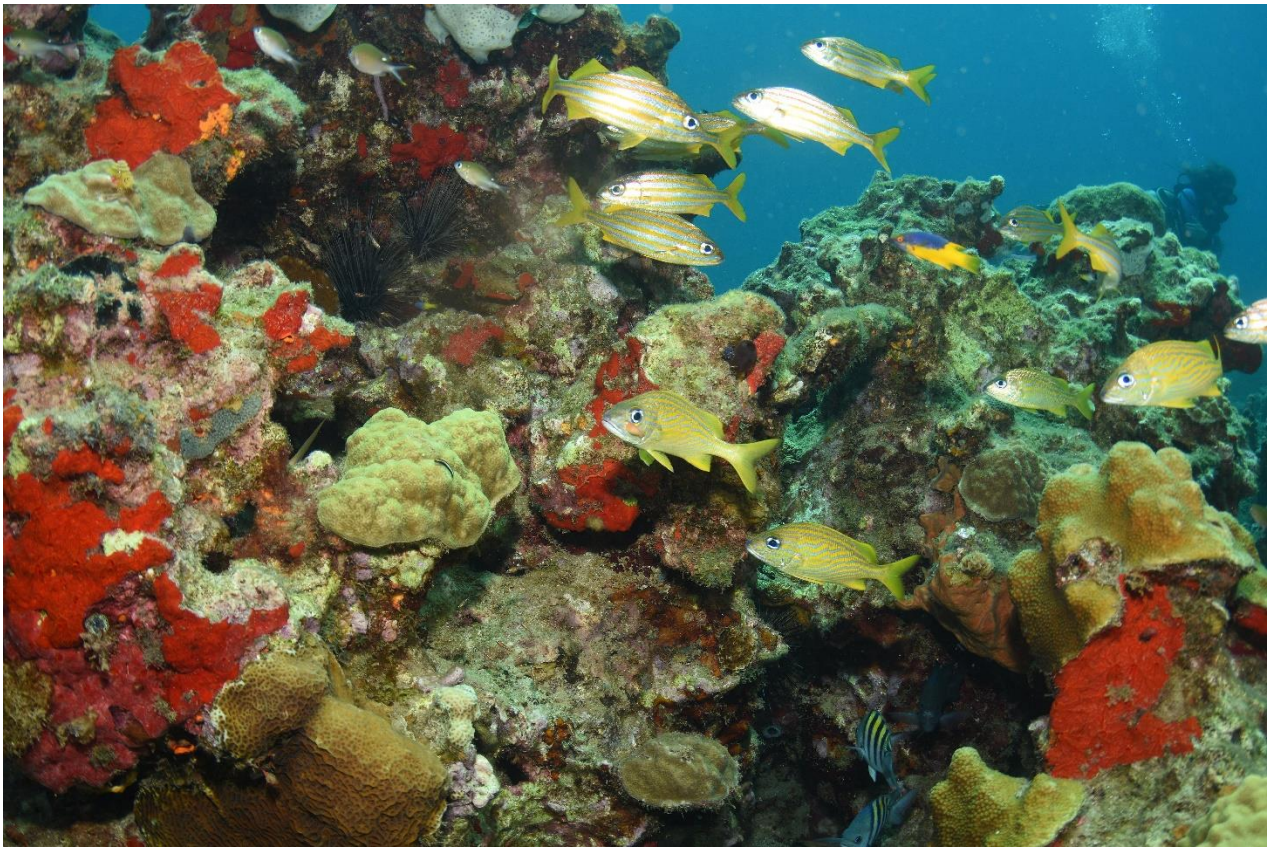


Above and below, Maggies Point, Mero (B.Holbrook/ReefCheck)



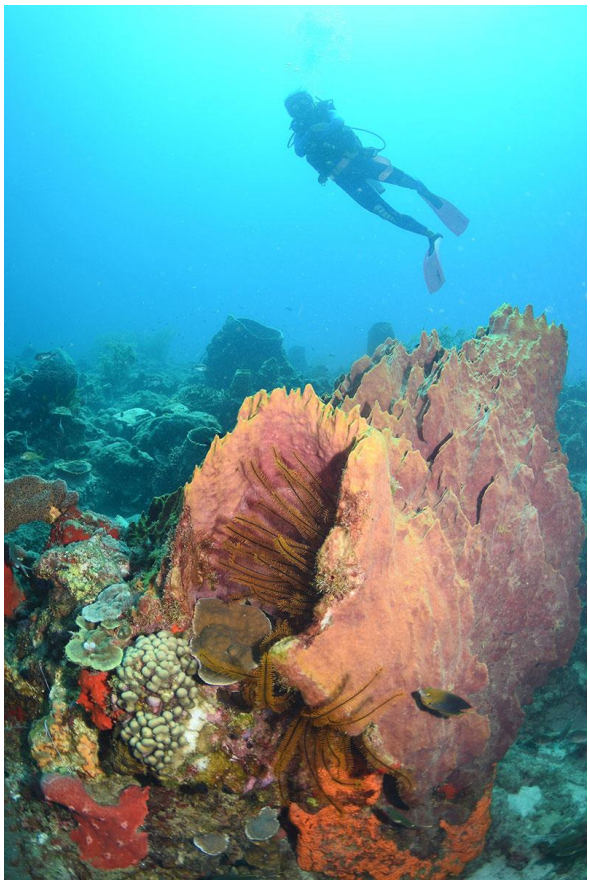


Rinas Reef, Grande Savanne. Showing sand erosion from the base of the outcrop



Douglas Bay Point, Cabrits

Tous Sable, Scotts Head



Tube Reef, Cabrits

Post storm view Danglebens Pinnacles, SSMR