Barbados

CORAL REEF REPORT CARD

2020 STATUS OF CORAL REEFS

A collaboration between:

COASTAL ZONE MANAGEMENT UNIT

CERMES UWI

Barbados is a small island developing state situated in the North Atlantic Ocean, and is the easternmost island in the Caribbean Lesser Antilles. It is about 168 km east of the islands of Saint Vincent and the Grenadines and 400 km north-east of Trinidad and Tobago.

N

294,560 people
(July 2020 est.)

Exclusive Economic Zone of 186,898 km²

<0.1 km² of mangrove

30.9% GDP from tourism (2019)

<0.1 km² of seagrass

430 km² of land

19.1 km² of coral

2.2 km² of designated marine protected area - Folkestone Marine Park

3 species of nesting sea turtles

Location of hard coral

Barbados

Message from the Director

Coral reefs are perhaps the most important, yet hidden ecological assets of Barbados. The fringing, bank and patch reefs that surround our island perform a number of functions that are important for our social, environmental and economic well-being. In order to obtain the full benefits from these ecosystems however, good health must be maintained. Empowered by the Coastal Zone Management Act, the Coastal Zone Management Unit (CZMU) of the Ministry of Maritime Affairs and the Blue Economy works in partnership to conserve these vital ecosystems.

A necessary first step for conservation is to acquire knowledge of the changes occurring in reef environments. To this end, the Government of Barbados, through the Coastal Zone Management Unit (CZMU) has been monitoring corals around Barbados since 1982 at five-year intervals. This programme, now comprising 47 sites, is one of the oldest and most consistent coral reef monitoring programmes regionally. While the data from this programme have been useful for technocrats and scientists, this Barbados Report Card forms part of a larger effort to provide the public and decision-makers with information needed for managing and conserving coral reef ecosystems. While this report presents the information from the most recent 2017 monitoring, as time progresses, additional areas of consideration will be added as we continue our progress toward successful reef management.

Dr. Leo Brewster - Director, Coastal Zone Management Unit, Barbados

Contents of the Card

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Why are coral reefs important?

ECOSYSTEM SERVICES

Supporting services

- Coastal protection
- Beach sand
- Support enormous biodiversity
- Critical habitat for commercial & endangered species
- Support associated ecosystems
- Nutrient recycling

Products

- Food
- Biomedical chemicals
- Curios/aquarium trade
- Building materials

Employment and livelihood

- Fisheries
- Tourism

Recreation/ aesthetic

- SCUBA diving/snorkeling
- Sport fishing
- Beauty of coral reef seascape

Educational/ spiritual/ inspirational purposes

- Teaching & research opportunities
- Cultural rituals & beliefs
- Creative inspiration

About the Reef Types

WEST COAST FRINGING REEFS

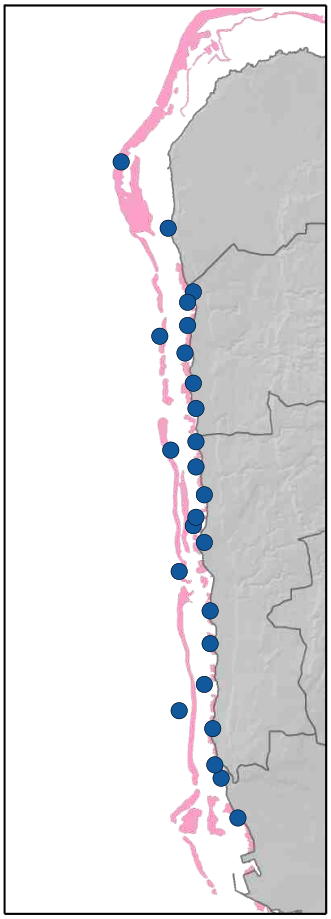
Fringing reefs are found all along the west coast, growing seawards from the beach to 100 to 200 m offshore. They are shallow (1 to 5 m deep) and have a characteristic spur and groove zone along the seaward edge.

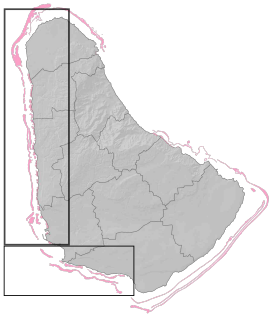
Mullins

SOUTH COAST PATCH REEFS

Patch reefs are isolated and generally more diffuse assemblages of coral found between the fringing reefs and the bank reef of the west coast, all along the south coast inside the bank and bank-barrier reef, and in some areas of the east coast.

Batts Rock



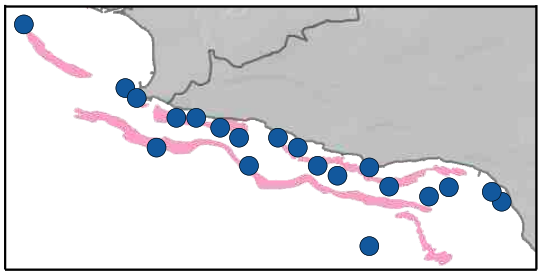


BANK REEFS

Bank reefs form a more or less continuous offshore wall running parallel to the shore, approximately 700 to 1000 m offshore, all the way from the most northern section of the west coast to the southeast point of the island.

The Farm

The top of this bank is relatively deep (15-25 m) along the west and southwest coasts, but is much shallower (2-5 m) along the southeast coast. Boats cannot pass over the crest of this shallow section and as such the reef here is referred to as a bank-barrier reef.

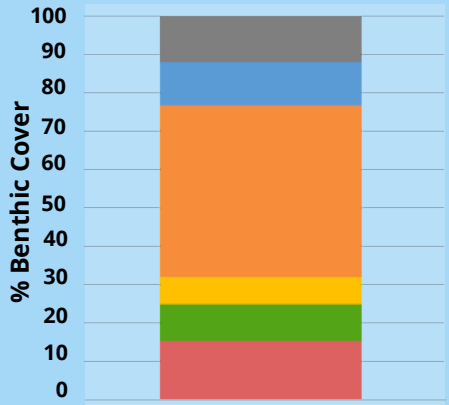
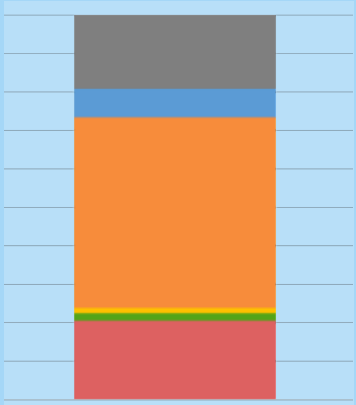
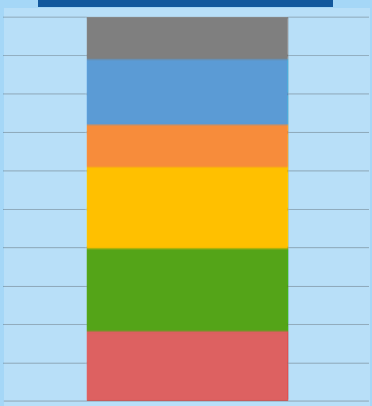
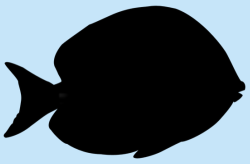
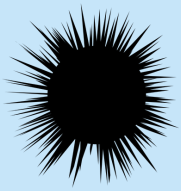


Worthing

Common Benthic Components of Barbados' Reefs

HARD CORALS	Living animals that build the reef's 3D structure of calcium carbonate. This provides shelter and living space for the diverse reef community and protects our coastlines.
MACROALGAE	Seaweeds, that when too abundant, outcompete corals for space on the reef.
SPONGES	Simple living animals with semi-rigid bodies that filter large amounts of water through their many pores and provide food and shelter for other reef organisms.
TURF ALGAE	Small or young seaweeds that cover hard surfaces in the reef and are continuously grazed by herbivores like fish and urchins.
CORALLINE ALGAE	Hard encrusting seaweeds that can form a coating over hard surfaces in the reef that looks like pink paint, and acts as a "reef cement". They provide a good surface for young corals to settle on and grow.
OTHER SUBSTRATE	Other components of the reef such as coral rubble, sand, crevices and other encrusting invertebrates (e.g. anemones, tunicates, gorgonians)
BLACK SEA URCHINS	Important reef herbivores that graze on turf algae and clear substrate for young corals to settle on.
GORGONIANS	Living animals with a tree-like appearance that dominate some reef communities providing shelter for many organisms. Their tough but flexible protein skeleton allows them to sway back and forth.

Composition of Barbados' Reef Types

	West Coast Fringing Reefs	South Coast Patch Reefs	Bank Reefs
% Benthic Cover			
GORGONIANS — All gorgonians (individuals/100 m²)	3	 222	 99
HERBIVOROUS FISH — Parrotfish and surgeonfish (g/100 m²)	 1082	 1953	 4198
COMMERCIAL FISH — Snappers and groupers (g/100 m²)	 13	 36	 1094
BLACK SEA URCHIN — *Diadema* urchins (individuals/100 m²)	 10	 24	0.4
LIONFISH — Red lionfish (g/100 m²)	none	 748	 2863

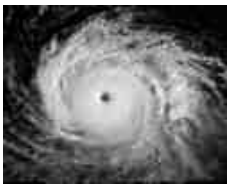
- OTHER SUBSTRATE
- CORALLINE ALGAE
- TURF ALGAE
- SPONGES
- MACROALGAE
- HARD CORALS

% Benthic Cover: 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, 0

Timeline

KEY EVENTS AFFECTING CORAL REEFS

1640s Extensive land clearing for sugarcane cultivation resulted in massive sedimentation and erosion, and the resultant desmise of staghorn and elkhorn (acroporid) coral reefs on Barbados' southeast coast



1950s Expansion of the fishing fleet

1955 Hurricane Janet (Category 5)

1950s - 60s Tourism boom begins

1960 Establishment of the Bellairs Research Institute, a field station for McGill University responsible for the earliest records of reef health

UWI

1974 Cave Hill Campus of the University of the West Indies established and stimulates reef research

Early 1980s Acroporid mass mortality from white band disease

1980 Establishment of first no-take MPA - *Folkestone Park and Marine Reserve*

1982

- Coastal Conservation Project Unit established; starts the National Coral Reef Monitoring Programme, with local and international scientists
- First documentation of a eutrophication gradient on the west coast of the island
- Establishment of the Bridgetown Sewage Treatment Plant

1983 Mass mortality of the black sea urchin (*Diadema antillarum)*

CERMES UWI

COASTAL ZONE MANAGEMENT UNIT

1991 Establishment of the Centre for Resource Management and Environmental Studies (CERMES), at the U.W.I. Cave Hill

1996 Coastal Zone Management Unit established

1998 **Mass coral bleaching event**

1999 Major fish kill event, attributed to *Streptococcus* bacteria carried in Orinoco river outflow

2001 - 2002 First coral disease survey (low but pervasive levels recorded)

2002 Establishment of the South Coast Sewerage Project, largely as a result of proving that corals deteriorated along a eutrophication gradient on the west coast

2003 – present

- Sporadic outbreaks of yellow band disease and black band disease observed
- White plague disease, dark spot disease and *Aspergillosis* remain at low levels

2005 **Mass coral bleaching event** (severe event - average 71% corals bleached in October); high bleaching associated mortality over the following year (26% coral cover lost)

2010 **Mass coral bleaching event** (less severe event - average 37% corals bleached in October); bleaching associated mortality over the following year (around 8% coral cover lost)

2011

- First influx of pelagic sargassum. Large strandings have continued until present day.
- Arrival of first invasive lionfish in November

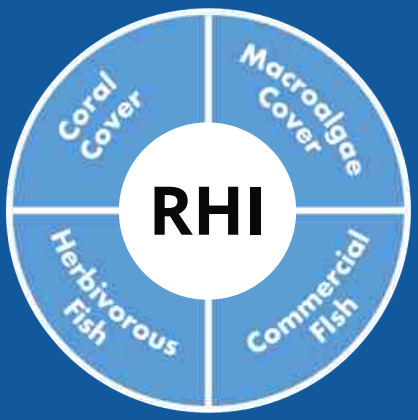
MINISTRY OF MARITIME AFFAIRS & THE BLUE ECONOMY

2015 - 2016 First experimental *ex-situ* coral nursery and a small amount of out-planting

2018 Establishment of Ministry of Maritime Affairs and the Blue Economy

2020

How Reef Health is Assessed



The Reef Health is assessed using four standard indicators, namely: **coral cover**, **macroalgae cover**, **key herbivorous fish abundance** and **key piscivorous or 'commercial' fish abundance**.

Each indicator is then assigned a score (from 1-5) based on its actual value with 1 being very poor and 5 being very good. The overall Reef Health Index (RHI) represents the **mean score** across the four indicators. These scores are shown around the outside of the circle and the overall RHI score is given in the centre.

Reef Health Indicators

SCORE	VERY GOOD 5	GOOD 4	FAIR 3	POOR 2	VERY POOR 1
CORAL COVER (%)	≥40.0	20.0 - 39.9	10.0 - 19.9	5.0 - 9.9	<5.0
MACROALGAE COVER (%)	0 - 0.9	1.0 - 5.0	5.1 - 12.0	12.1 - 25.0	>25.0
HERBIVOROUS FISH (g per 100m²)	≥3480	2880 - 3479	1920 - 2879	960 - 1919	<960
COMMERCIAL FISH (g per 100m²)	≥1680	1260 - 1679	840 - 1259	420 - 839	<420

Health Indicators Explained

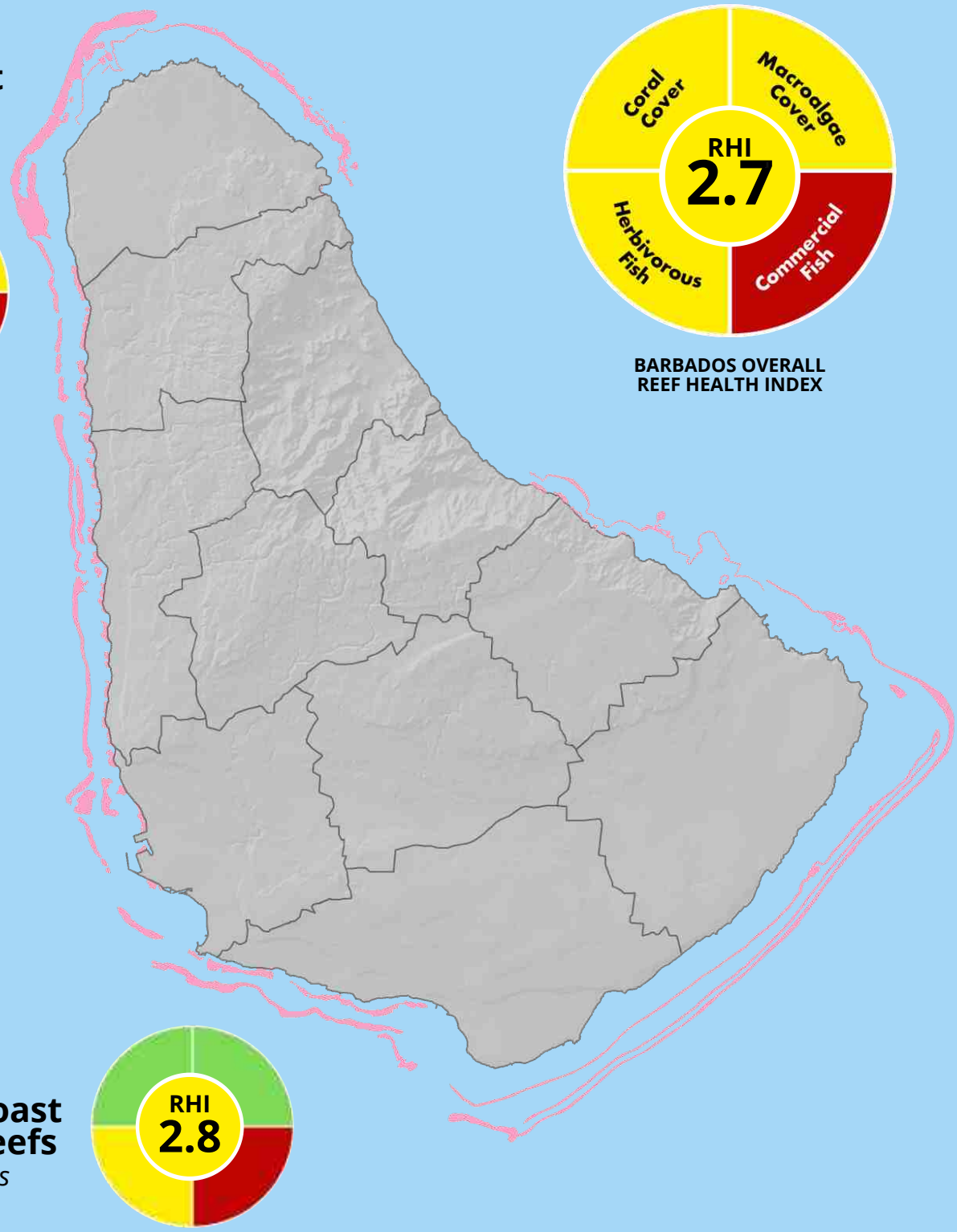
Coral cover describes the amount of reef surface that is taken up by living hard corals

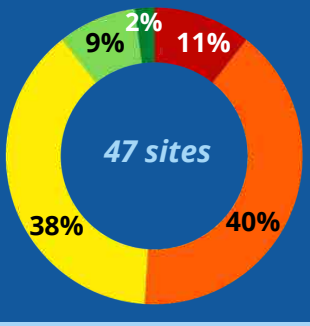
Herbivorous fish is a measure of the biomass of important grazers on seaweeds that could overgrow the reef - namely parrotfishes and surgeonfishes

Macroalgae cover describes the amount of reef surface that is taken up by seaweeds

Commercial fish is a measure of the biomass of carnivorous fish species that are commercially important to people - namely snappers and groupers

Status of Barbados' Coral Reefs (2017)





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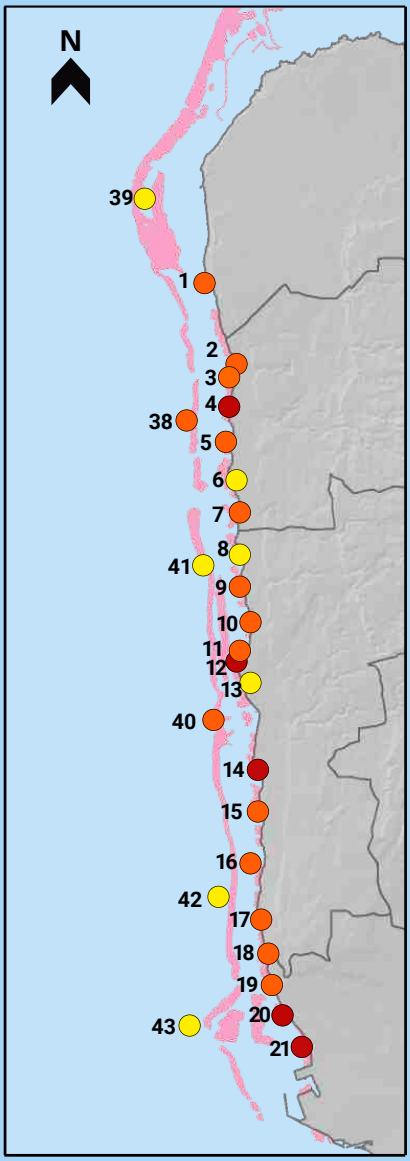
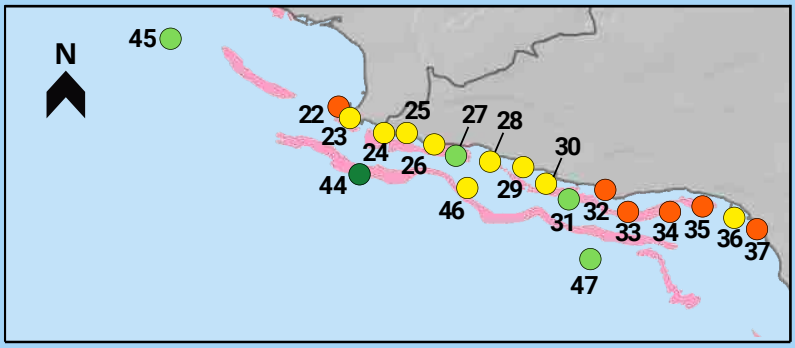




WEST COAST FRINGING REEFS

1 Six Men's
2 Heywoods
3 Speightstown
4 Plantations
5 Sandridge
6 Mullins
7 Greensleeves
8 Tropicana
9 Driftwood
10 Jet Ski
11 Bachelor Hall
12 Heron Bay
13 South Bellairs
14 Sandy Lane
15 Bamboo Beach Bar
16 Barbados Beach Village
17 Fitts Village
18 Batts Rock
19 Paradise
20 Power Plant
21 Brighton

SOUTH COAST PATCH REEFS

22 Carlisle Bay
23 Hilton
24 Asta
25 Coconut Court
26 Ocean View
27 Windsor Arms
28 Accra
29 Blythwood
30 Sandy Beach
31 Josef's
32 Southern Palms
33 Rainbow Reef
34 Casuarina
35 Windsurfer
36 Union Villa
37 Southern Plaza

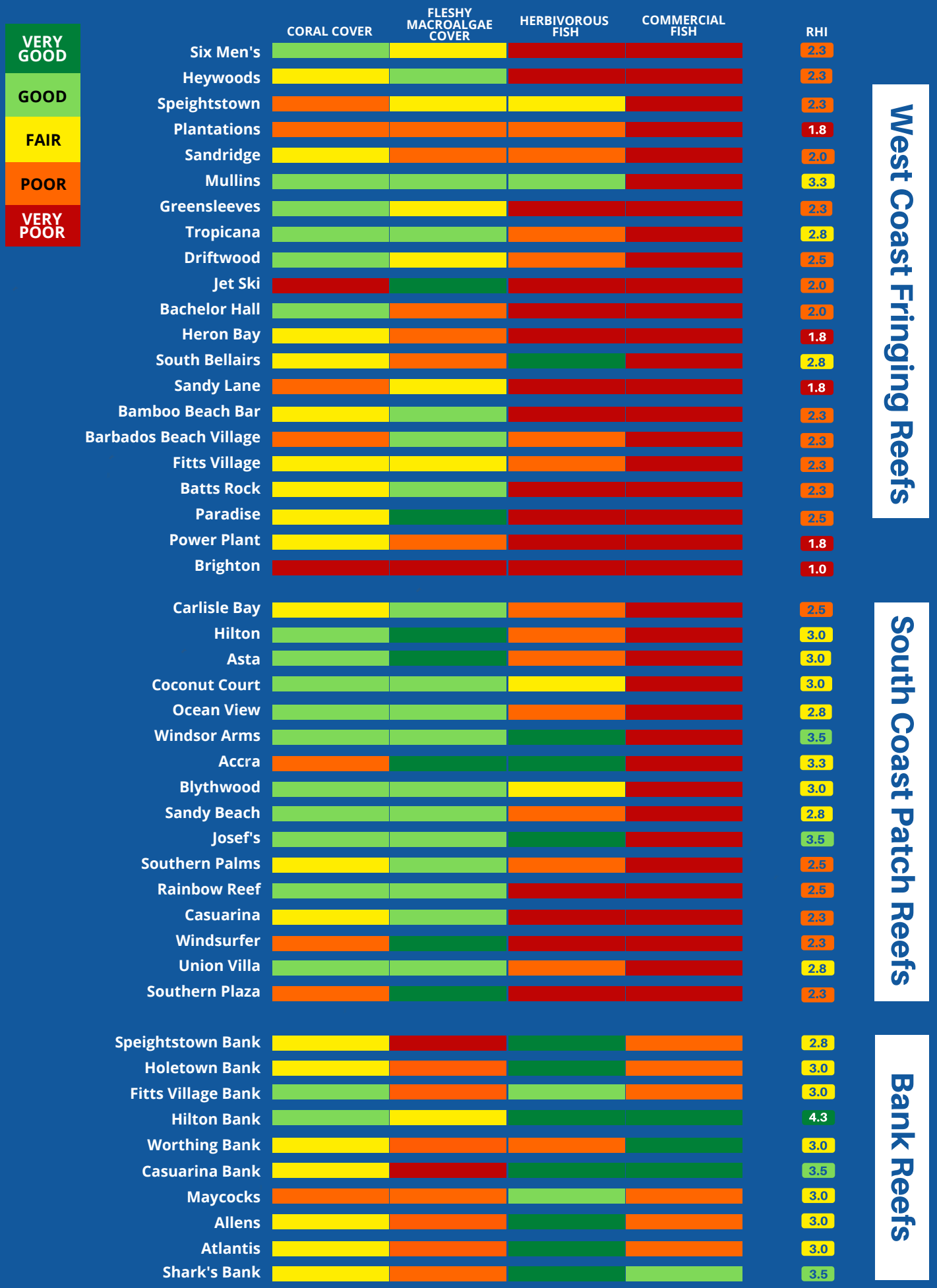
BANK REEFS

38 Speightstown Bank
39 Maycocks
40 Holetown Bank
41 Allens
42 Fitts Village Bank
43 Atlantis
44 Hilton Bank
45 Shark's Bank
46 Worthing Bank
47 Casuarina Bank

VERY GOOD | GOOD | FAIR | POOR | VERY POOR

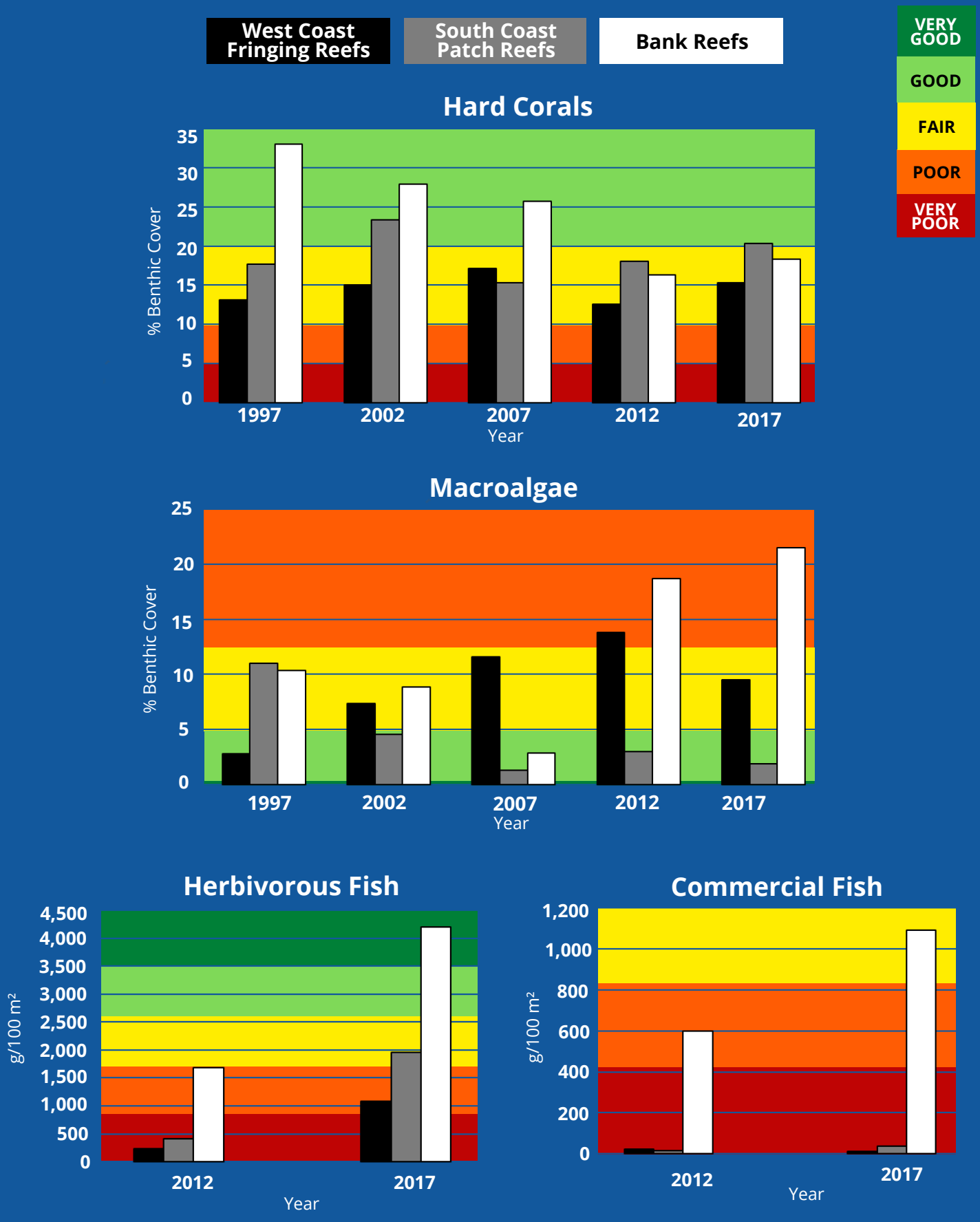
Location of hard coral

Site-by-Site Breakdown of Reef Health



From then to now: Twenty years of change

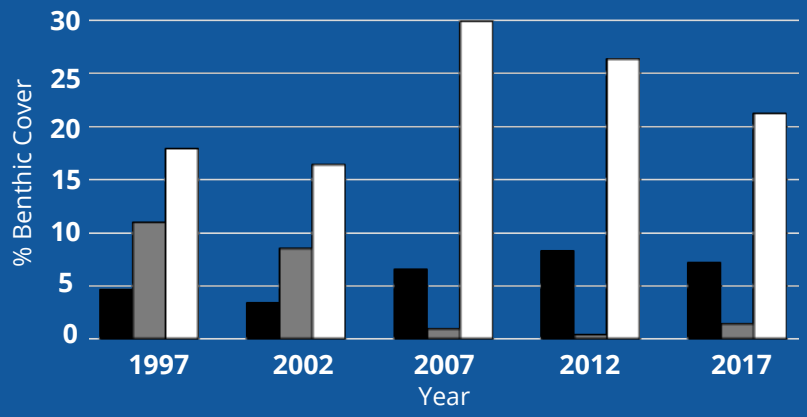
Components of reef health



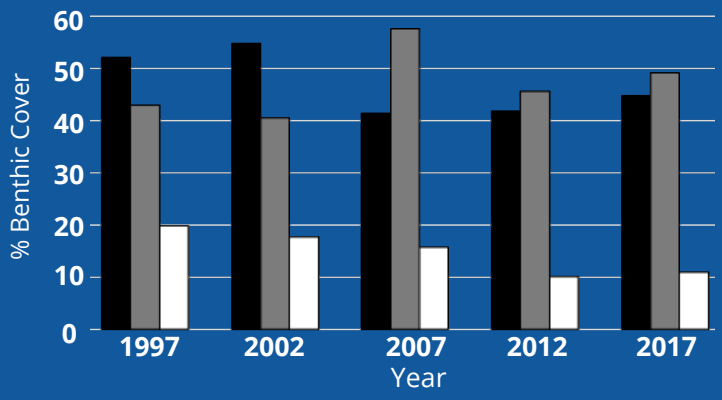
Other coral reef components

West Coast Fringing Reefs | South Coast Patch Reefs | Bank Reefs

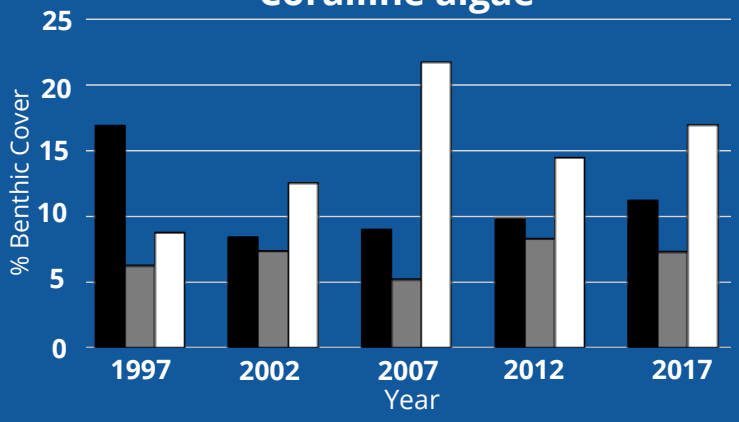
Sponges



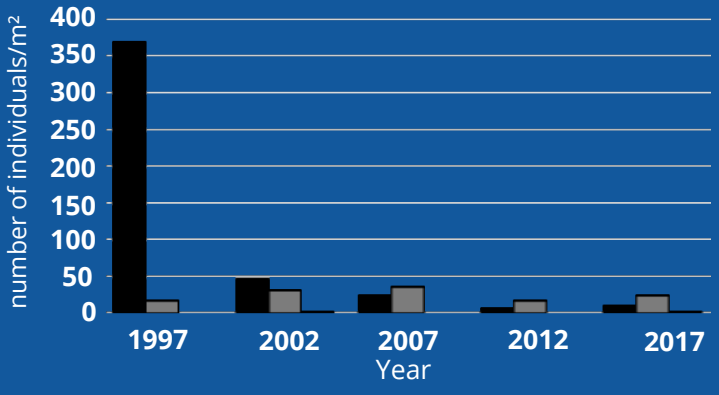
Turf algae



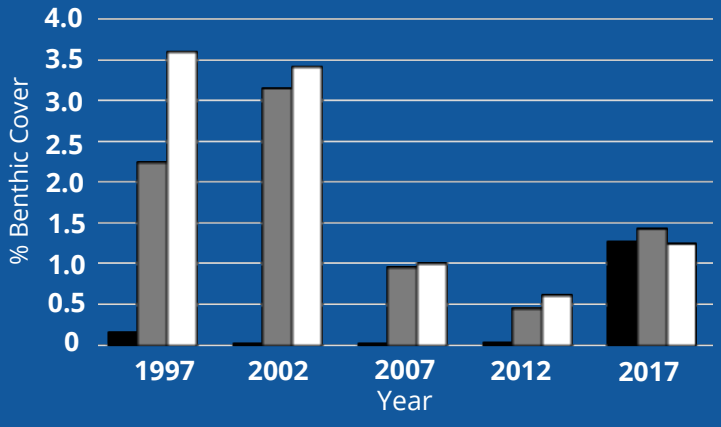
Coralline algae



Diadema sea urchins



Gorgonians



Stressors

What factors have driven the coral reefs to change over the last few decades?

- **Deteriorating water quality**
  - Nutrients and sediments
- **Climate change**
  - Warmer seas and more severe storms
  - Ocean acidification
- **Overharvesting**
  - Unsustainable fishing
  - Collection of curios
- **Physical damage**
  - Marine construction
  - Anchor damage
- **Invasive species**
  - Lionfish

Deteriorating water quality

- *Nutrients and sediments*
- *Solid waste and toxins*

NOAA

SOURCES/ISSUES

SOURCES

- Seepage from suckwells
- Run-off from coastal construction
- Marine construction/dredging
- Removal of coastal vegetation (e.g. mangroves)
- Illegal dumping and littering
- Run-off from agricultural and domestic lands, golf courses, and built-up areas with impervious surfaces (concrete, asphalt)

ISSUES

- **High nutrient loads** fertilize the phytoplankton in the water column and the seaweed on the reef, blocking the light that corals need to feed and overgrowing them
- **High sediment loads** block light from reaching the corals and can settle over the reef smothering it and killing corals and other invertebrates
- **Solid waste** smothers and injures corals and other animals and microplastics enter the food chain
- **Chemicals** that may not be very toxic to humans are often devastating to marine organisms because they have porous skin and 'breathe' the water

WHAT HAVE WE DONE?

- Single use plastics and styrofoam containers are now prohibited by law
- Constructed the Bridgetown and South Coast Sewage Treatment Plants
- Town and Country Planning Act (1972), and the Marine Pollution Control Act (1998) - which govern and regulate coastal activity and marine environmental health
- Environmental impact assessments are required before construction on the coast is permitted
- Water quality is monitored reguarly by the Coastal Zone Management Unit (reefs) and the Environmental Protection Department (bathing beaches)

The average time for a plastic bottle to completely degrade is at least 450 years!

What can you do?

- Never dispose of your waste in the sea, or in gullies
- Choose porous surfaces around your home and install soakaways or reduce rainwater runoff
- Choose eco-friendly cleaning products and natural pesticides
- Do not over fertilize your garden
- Install septic tanks for residential properties along the coast

Climate change

- *Warmer seas and more severe storms*
- *Ocean acidification*

SOURCES/ISSUES

SOURCE

The increase of greenhouse gas in the atmosphere as a result of the burning of fossil fuels has resulted in a number of adverse impacts:

ISSUES

- **Warmer sea surface temperatures** results in mass bleaching and mortality of corals, and disrupts reproductive cycles of marine organisms
- **More severe storms** with very rough seas and high rainwater runoff from the land causes significant physical damage to reefs, breaking corals and uprooting gorgonians and sponges, and smothering the reef community
- **Ocean acidification** can affect the ability of corals to produce the reef framework (which may ultimately erode and dissolve), and prevent marine organisms from building their protective shells. It can also result in nerve damage to the young larvae of marine organisms resulting in greater mortality
- **Sea level rise** will result in coastal erosion and sand being washed back onto the reef smothering it. A common human response to eroding coastlines is to build groynes and offshore barriers which may also negatively impact the nearshore reefs

Bleached mountainous star coral after a mass coral bleaching event

WHAT HAVE WE DONE?

- Barbados signed the *Paris Agreement under the United Nations Framework Convention on Climate Change* - which is a pledge to play their part in keeping global temperatures from increasing more than 2 °C
- The Barbados National Energy Policy 2019-2030 includes the goal to achieve 100% Renewable Energy by 2030
- CZMU and UWI continuously monitor sea water temperature and incidences of coral bleaching
- CZMU has conducted initial research on the feasibility of coral restoration (coral nursery and outplanting)

A hospital in Barbados fitted with photovoltaic panels for solar hot water system

What can you do?

- Save electricity by using LED bulbs in light fixtures
- Convert to renewable energy wherever possible – such as using solar water heating, electric vehicles, photovoltaic panels for electricity
- Carpool when possible
- Turn off the car engine when parked

Overharvesting

- *Unsustainable fishing*
- *Collection of curios*

SOURCES/ISSUES

WHAT HAVE WE DONE?

SOURCES

- **Unsustainable fishing** occurs when the harvest rate exceeds the natural replenishment rate of fish populations
- **Collection of marine organisms as curios** often for sale to visitors and locals as souvenirs and ornaments

ISSUES

- Overharvesting removes reef species and the ecological balance of the entire reef community is affected. For example, reefs without enough grazing fish can get overgrown by seaweeds and cause the corals to die
- Reduces the resilience of the reef to climate change and other stressors
- Reduces biodiversity

- Established the no-take Folkestone Park and Marine Reserve to help replenish over-harvested fish and curios
- Barbados is a member of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) – which controls or prevents the export of listed marine animals (e.g. queen conch, sea turtles)
- The CZMU Act (1998) forbids the harvesting and sale of any corals
- Extensive research on the marine and coastal environment conducted by the University of the West Indies

Over-harvesting of grazing fish can result in coral reefs becoming overgrown with seaweeds, causing the corals to die.

UWI students monitoring reef fish with local pot fisher.

Souvenirs for sale.

What can you do?

- Avoid eating 'pot fish'.
- Never purchase souvenirs/curios of wild animals such as corals, starfish, seahorses and shells!
  - Instead, support artisans who sell well-crafted replicas
- Report illegal activity related to the marine environment anonymously to Crime Stoppers Barbados.

Physical damage

- *Marine construction*
- *Anchor damage*

SOURCES/ISSUES

SOURCES

- Construction of protective rock barriers and groynes, jetties and piers
- Unregulated anchoring of ships and pleasure craft, and grounding of vessels
- Dredging to increase depth or to use sand reserves
- Creating additional dry land by filling marine areas
- Heavy use of dive sites with touching, standing on and accidental breakage of corals

ISSUES

- Coral tissue injury
- Breaking coral skeletons
- Knocking over coral colonies
- Large scale removal of reef framework
- Large scale burying of reef

Construction of groyne at a west coast hotel

Never walk or stand on coral reefs!

WHAT HAVE WE DONE?

- Coastal Zone Management Act - which makes damage to coral reefs illegal, and the Town and Country Planning Act of Barbados - establishes the requirement for planning permission with strict conditions for any marine construction
- Installation of mooring buoys at select dive sites and locations for large visiting yachts, to prevent anchoring in coral reefs

Recreational yacht tied off to a mooring buoy

What can you do?

- Never walk or stand on coral reefs (especially with fins)
- Adjust your buoyancy when diving to avoid touching the reef or landing on coral
- Always tie off vessels to mooring buoys, and avoid anchoring on corals
- Voice your concerns about new coastal developments during public consultations

Invasive species

▶ Lionfish

Hazel Oxenford

SOURCES/ISSUES

WHAT HAVE WE DONE?

SOURCE

Introduction of the Indo-Pacific lionfish to the Atlantic occurred in the 1980's from saltwater aquaria in the US. Following their introduction, unchecked expansion of the lionfish population occurred as a result of rapid reproduction combined with an absence of natural enemies. This has a number of implications:

ISSUES

- **Lower recruitment success** of native reef fish, especially juvenile fish
- **Venomous spines** can cause injury to fishers and divers if mishandled or through accidental contact

A flyer from 2014 of a local lionfish derby. Remember to eat them to beat them!

Hazel Oxenford

Fishing team with their catch at the 2015 lionfish derby

- Implemented a lionfish response plan at the first lionfish sighting in Barbados. This entailed a number of activities co-ordinated by CZMU, UWI and the Fisheries Division including:
  - Manning a 24-hour hotline for reporting lionfish sightings and answering questions
  - A series of stakeholder training workshops on safe handling and processing of lionfish to eat
  - A lionfish 'cook-off' by local chefs with free public tasting
  - Invitational lionfish derbies with attractive prizes
  - Regular lionfish culling dives in Folkestone Marine Park
- This has resulted in the development of a commercial and recreational fishery for lionfish which has been successful in preventing unchecked expansion of lionfish numbers

USA Today, Liz Clayman

What can you do?

Eat them! Once their venomous spines are safely removed, these are delicious food fish.

Mangroves and Seagrasses

Mangrove wetlands and seagrass meadows are other coastal habitats that often exist alongside coral reefs. These three habitats have complex interactions which influence the development and survival of one another.

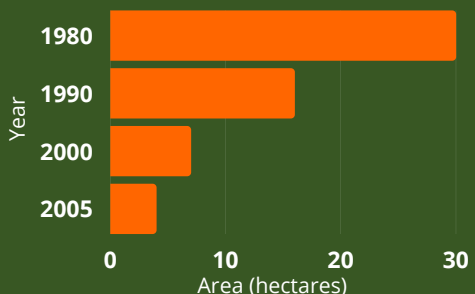
'**Mangrove**' is a generic term used to define the group of woody, salt tolerant plants that grow along tropical and sub-tropical shores like Barbados. The mangrove ecosystem refers to the entire assemblage of diverse marine and terrestrial plants and animals that live in the mangrove wetland.

Seagrasses are marine flowering plants, not seaweeds or grasses as the name would imply. They may occur in small beds, together with mangrove tree roots and small coral colonies, or as vast undersea meadows many square kilometres in size.

Tall red mangrove (*Rhizophora mangle*) trees in Graeme Hall swamp

Estuarine habitat restoration in Constitution River showing young mangrove trees.

How has mangrove abundance changed over the years?



Halophila decipiens bed in deep water in Carlisle Bay

Why have these ecosystems deteoriated over time?


Removal of mangrove trees for the construction of coastal hotels and villas


Poor water quality and sedimentation due to polluted run-off from inland sources


Excavation of seagrass beds for 'beach beautification'


Excessive grazing by sea urchins

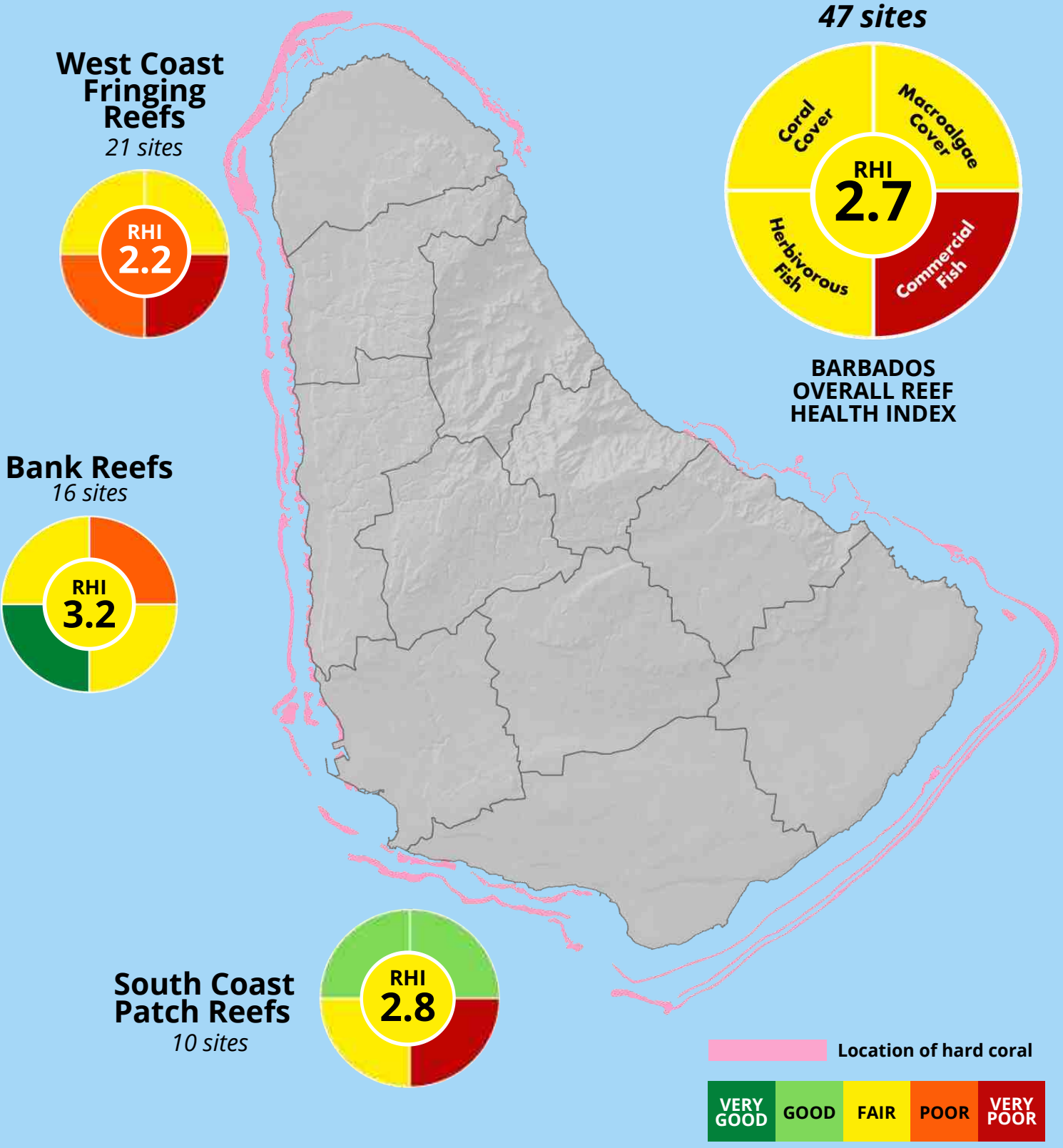
Queen conch

Sea cucumber

Green sea turtle

Red cushion sea star

Status of Barbados' Coral Reefs (2017)



STATUS OF CORAL REEFS IN THE EASTERN CARIBBEAN (2015)

Saint Kitts & Nevis	Antigua & Barbuda	Dominica	Saint Lucia	Saint Vincent & the Grenadines	Grenada
2.3 (25 sites)	2.3 (29 sites)	2.8 (16 sites)	2.8 (17 sites)	2.8 (42 sites)	2.5 (27 sites)