STATUS OF CORAL REEFS OF THE GUADELOUPE ISLANDS

How healthy are the archipelago's coral reefs?

→ OBJECTIVE OF INDICATOR

This indicator aims to provide a state of knowledge on coral reefs in the islands of Guadeloupe and to assess their health status. This ecosystem is consistently monitored, both in protected and in high-stakes areas. About thirty monitoring stations have been set up, some of which operating for over 20 years.

All the data collected to date is what brings us now understanding of this ecosystem as well as the capacity to assess its overall health condition, which is constantly deteriorating.

The indicator synthesises data available at the scale of the Guadeloupe archipelago, to highlight key takeaways in terms of threats to the various groups of species that make up the reefs, and measures implemented for their conservation.

▲ *Pigeon Islet, Malendure.*
© Franck Mazéas

[1] Corals are composed of small animals called polyps, resembling small sea anemones. Polyps form the building blocks of a coral colony, which can comprise several thousand individuals yet functions as a single unit. Polyps maintain a symbiotic relationship with microalgae, which provide them with the energy they require and give the coral its color.

[2] Refers to a species that lives on the seabed.

SUMMARY RESULTS

214 km² of coral formations (**corals**[1] *and other associated* **benthic**[2] *populations*)
GIS layer DEAL, 2011

30 + **stations** monitored periodically

21 coral species in the Caribbean **threatened with extinction**

i.e **43%** of the assessed species
IUCN Red List of Threatened Species (2022)

2023 Year of last **extreme bleaching** event

89% of the reefs sampled are **degraded**

16 **protected** coral species

CONTEXT

Coral reefs[3] are complex and diverse ecosystems, that play a **key role** in supporting biodiversity. In fact, they host over **25%** of the world's marine species diversity *(GCRMN, 2020)*. The intricate nature of these peculiar ecosystems heightens their vulnerability to **environmental changes**, especially in the face of global changes. They **provide numerous services to humans**, including protecting coastlines by absorbing wave energy, **offering numerous habitats for the life**, **feeding and reproduction of various species** (fish, crustaceans, mollusks, etc.) —including many of commercial interest— and supporting the growth of **seagress beds** [4] sheltered within their lagoons.

> *The degradation of coral reefs leads to a considerable loss of biodiversity and jeopardises the balance of the entire ecosystem.*

▲ Butterflyfish (*Chaetodon capistratus*) and coral colony (*Porites furcata*) *© Thibaud Simoncini*

The **proportion of living corals is declining at an alarming rate** with a near **4% loss over the past decade**. We are now facing a concerning global situation: approximately **50%** of the world's tropical coral reefs have already disappeared *(GCRMN 2020; IPBES 2019)*, and over **1/3** of coral species **face extinction** *(IUCN Red List of Threatened Species)*.

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[3] Underwater formation generated as limestone skeletons of dead corals (Scleractinians) pile up.

[4] Groupings of flowering plants (Phanerogams, not algae) that form seagrass meadows.

RESULTS

1. State of knowledge

Coral reefs around the Guadeloupe archipelago have been studied for over 30 years, with monitoring networks gradually set up since the 2000s.

Milestones in monitoring networks

1981
« Corantilles I » Mission
Slow deterioration observed from some sites, with a decrease in corals and the associated wildlife, that fueled the expansion of the algal cover

1989
Creation of the **Guadeloupe National Park**
Parc national de la Guadeloupe

1994
The **ICRI** (International Coral Reef Initiative) is founded by 8 countries

1999
Creation of **IFRECOR** (French Initiative for Coral Reefs)

1998
Creation of the *Petite Terre Islands* **National Nature Reserve**

1995
The **GCRMN** (Global Coral Reef Monitoring Network) is founded by the ICRI

2002
Launch of **GCRMN monitoring** in Guadeloupe

2007
Launch of monitoring in **marine protected areas** (Reserve, National Park)
Launch of monitoring by **Reef Check Guadeloupe**

2008
Launch of **WFD** (Water Framework Directive)

Coral colonies and their health status have been monitored for over 20 years by various networks, coordinated at the international, national and local levels.

Since the 1980s, the increased frequency of coral **bleaching events**[5] has had harmful and sometimes irreversible consequences for corals. Monitoring these phenomena as well as their impacts on coral survival is essential for assessing the state of coral reefs.

In 1983, the average cover of live hard corals in the Caribbean region was estimated at **18%** compared to **15.9%** in **2019** —with significant regional variations nonetheless *(GCRMN, 2020)*. Massive coral bleaching events (1998, 2005) combined with regional events such as diseases and hurricanes (Hugo in 1989, Lenny in 1999, Irma in 2017, etc.) have strongly affected coral reefs.

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[5] When environmental conditions are unfavorable, corals expel their microalgae and lose their colors, exposing their calcareous and white-colored external skeleton.

Benthic monitoring involves collecting data on a regular basis at designated sites (stations) located on the seabed. Key parameters monitored include **coral community coverage**, **macroalgae coverage**, as well as the settlement of young coral on the reef (**larval recruitment**).
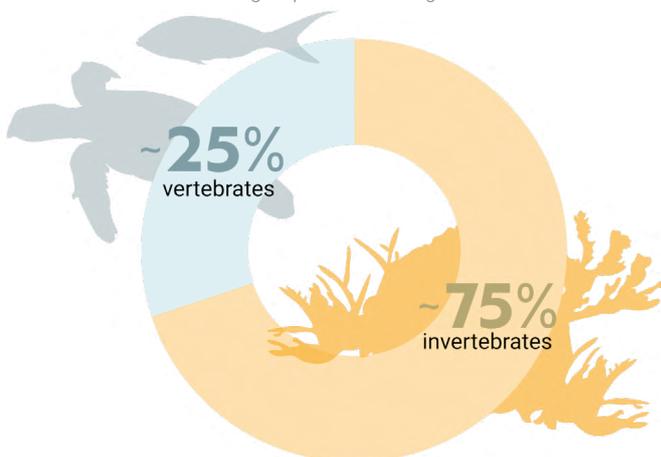
Benthic monitoring report

Monitoring network		Number of stations	
		2008	2024
GCRMN	GCRMN	5	4
Marine Protected Areas		3	4
Reef Check		2	9
WFD		9	16
Total		**19** +14	**33**

▲ Figure 1: Number of benthic monitoring stations per monitoring network in 2008 and 2024.

⟶ **Between 2008 and 2015, the number of monitoring stations across the various networks increased by almost 60%.**

2. Diversity of species groups found in coral reefs

Coral reefs are **habitat**[6] to many species. Reef species depend on these reefs **for part or all of their life cycle**, while reef-associated species include marine species that use coral reefs, but do not depend exclusively on this habitat for their survival.**Thus, coral reefs are populated by a multitude of species belonging to different groups.**

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[6] All the specific environmental conditions (physical, chemical and biological) that a species requires to survive, grow and reproduce.

Reefs are **dominated by invertebrate communities** (animals without backbone such as mollusks, corals, sponges, etc.), while **marine vertebrates** (fish, sharks and rays, sea turtles for instance) **represent a minority**.
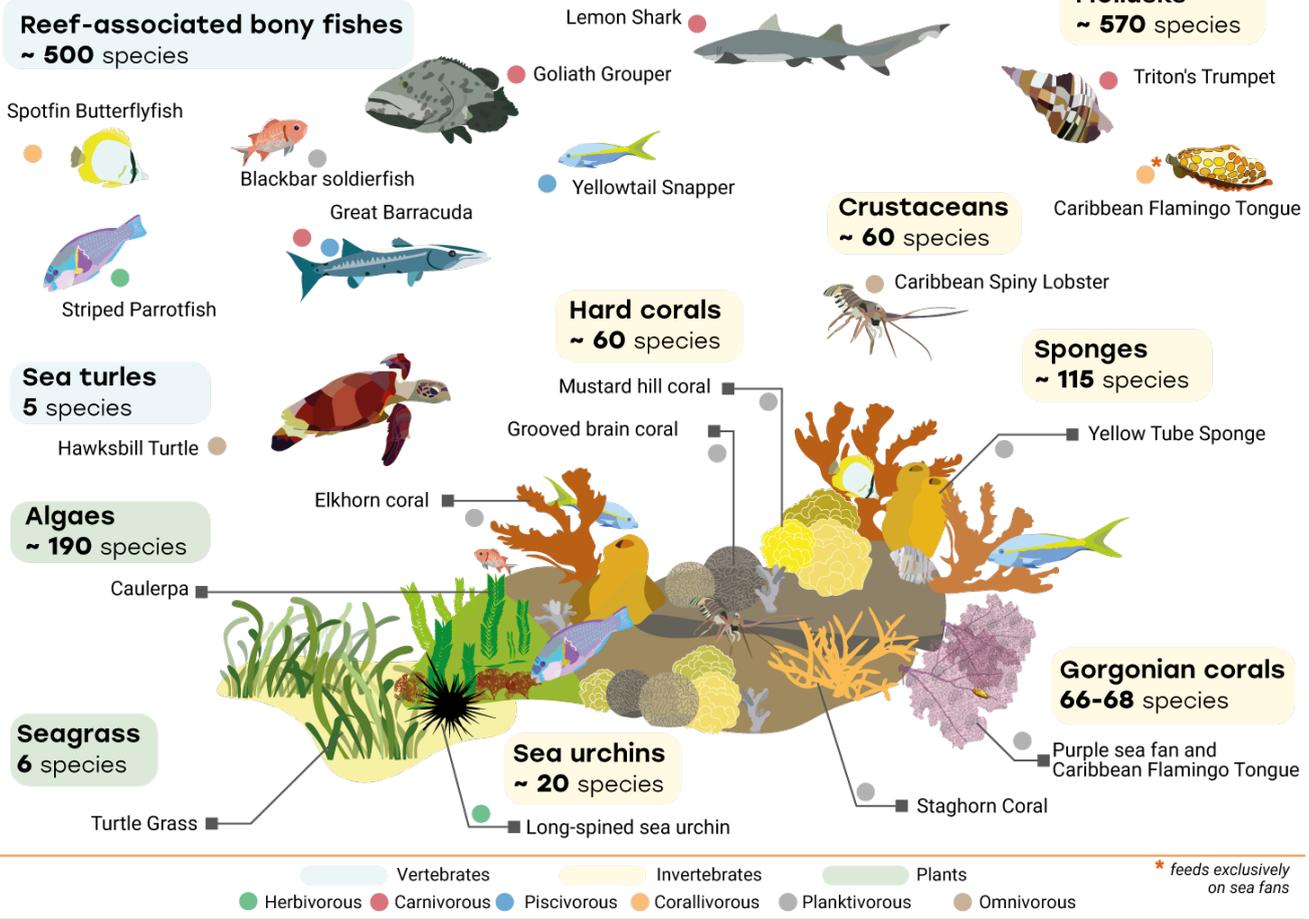
▼ Figure 2: Estimated proportion of vertebrate and invertebrate groups found in the coral reefs of Guadeloupe.

Based on the taxonomic groups shown in *Figure 3*.

~25% vertebrates

~75% invertebrates

◀ Petite Terre Lagoon
© Franck Mazéas

Species richness and interactions in coral reefs

Reef-associated bony fishes ~ 500 species

Spotfin Butterflyfish
Blackbar soldierfish
Great Barracuda
Striped Parrotfish

Sharks & Rays 13 species

Lemon Shark
Goliath Grouper
Yellowtail Snapper

Mollusks ~ 570 species

Triton's Trumpet
Caribbean Flamingo Tongue

Crustaceans ~ 60 species

Caribbean Spiny Lobster

Sea turtles 5 species

Hawksbill Turtle

Hard corals ~ 60 species

Mustard hill coral
Grooved brain coral
Elkhorn coral

Sponges ~ 115 species

Yellow Tube Sponge

Algaes ~ 190 species

Caulerpa

Seagrass 6 species

Turtle Grass

Sea urchins ~ 20 species

Long-spined sea urchin

Gorgonian corals 66-68 species

Purple sea fan and Caribbean Flamingo Tongue
Staghorn Coral

Vertebrates · Invertebrates · Plants

feeds exclusively on sea fans

● Herbivorous ● Carnivorous ● Piscivorous ● Corallivorous ● Planktivorous ● Omnivorous

▲ **Figure 3:** Number of reef-associated species, and their diets (color dots).
Some carnivores have specialised diets, such as piscivores that feed exclusively on fish, corallivores that feed on corals, and planktivores that feed on plankton (very small animals and plants that live in water).

3. Coral reef functions

There are **three main types of reef formations** around the Guadeloupean archipelago, that have different functions.

BARRIER REEF
It acts as a **barrier against the swell** and **gives shelter** to many juvenile and adult species in the lagoon.
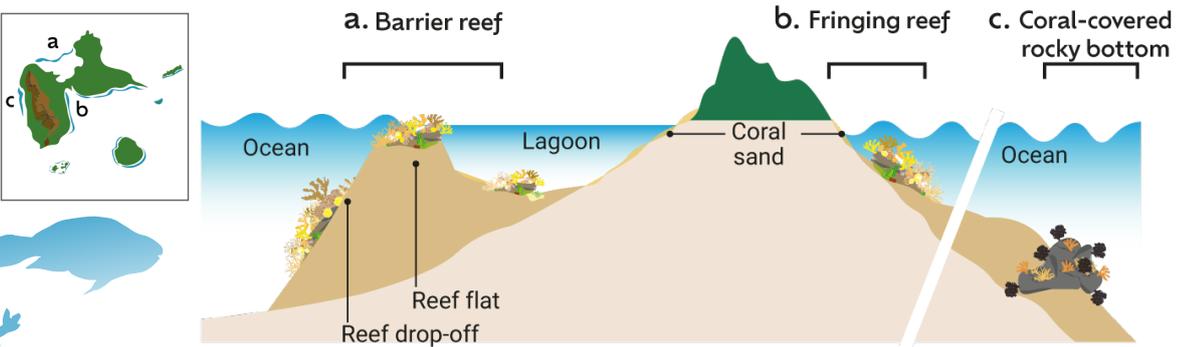
FRINGING REEF
It is home to **spawning areas** (where certain species breed) and **nurseries**, where the juveniles of many fish species, including species of commercial interest, gather and shelter.

CORAL-COVERED ROCKY BOTTOM
Rocky bottoms with coral communities more diverse and vibrant than Atlantic reef formations.

Figure 4: Diagram showing the different types of reefs found in Guadeloupe and their main location.
According to *IFRECOR* (2021)

a. Barrier reef
b. Fringing reef
c. Coral-covered rocky bottom

Ocean
Lagoon
Coral sand
Ocean
Reef flat
Reef drop-off

All reef species interact with one another through food chains, forming a **complex network of interactions**. The **complexity of a coral reef's food web reflects a healthy ecosystem**, while its simplification indicates an imbalance. Indeed, whenever a link in the chain disappears due to human and/or natural pressures, it leads to reef degradation.

The accumulation of mass mortality events of the Carribean _long-spined sea urchin_ since the 1980s, combined with intensive exploitation of parrotfish for human consumption have led to a decline in herbivores, contributing to the no longer regulated proliferation of algae on the reefs.

Degradation of surrounding water quality is a factor that fosters both the emergence and development of coral diseases, which can also lead to a decline in the abundance of fish and other marine species, thereby altering communities.

Stoplight Parrotfish
© Franck Mazéas

→ **Maintaining the integrity of the food chain network is essential to safeguarding the many functions of coral reefs.**

4. Species conservation status

What is the IUCN Red List ?

The **IUCN Red List of Threatened Species**[7] can be produced at the global, national or regional level and is based on a proven scientific methodology.
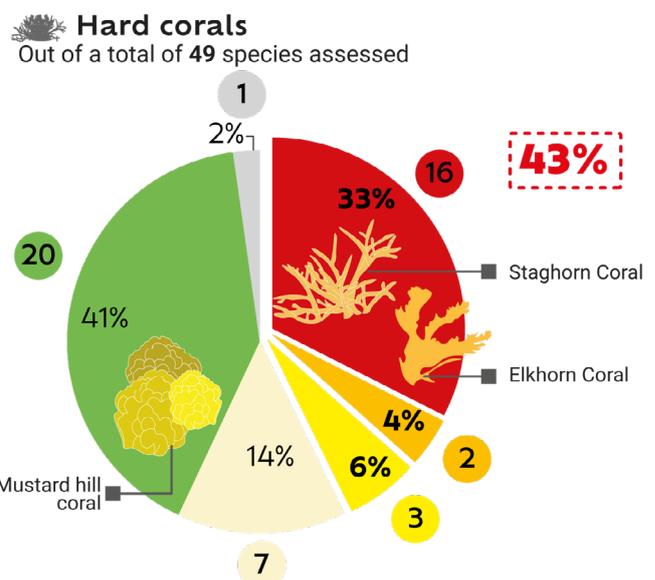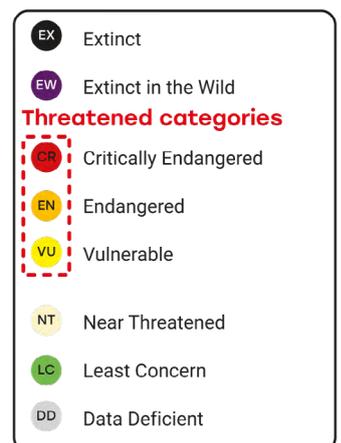
Experts for the different groups of assessed species evaluate the state of biodiversity at the territorial level, determine the degree of threat facing the species, and estimate their risk of extinction in order to assign them to a specific category.

Figure 5: IUCN Red List ▶ Main categories.
Source : _IUCN French Committee_

EX Extinct
EW Extinct in the Wild
Threatened categories
CR Critically Endangered
EN Endangered
VU Vulnerable
NT Near Threatened
LC Least Concern
DD Data Deficient

[7] International Union for Conservation of Nature.

| _Threatened species are at greater risk of extinction than others._

Corals are sensitive to environmental changes such as rising ocean temperatures, storm damage and different types of pollution. In particular, populations of _Elkhorn_ and _Staghorn_ corals have been decimated by the "white band" disease that surged in the 80s. The decline of these species has also been driven by other factors, including **water quality degradation** and warming that induce **coral bleaching events**, and **algal blooms** that limit the settlement of coral larvae on the reef.

Hard corals
Out of a total of **49** species assessed

1 — 2%
16 — **43%**
33%
Staghorn Coral
Elkhorn Coral
4% — 2
6% — 3
20 — 41%
Mustard hill coral — 14% — 7

▲ **Figure 6:** Conservation status of hard corals found in Guadeloupe and on the IUCN Red List (2022).
In the circles, the number of species corresponding to each category.
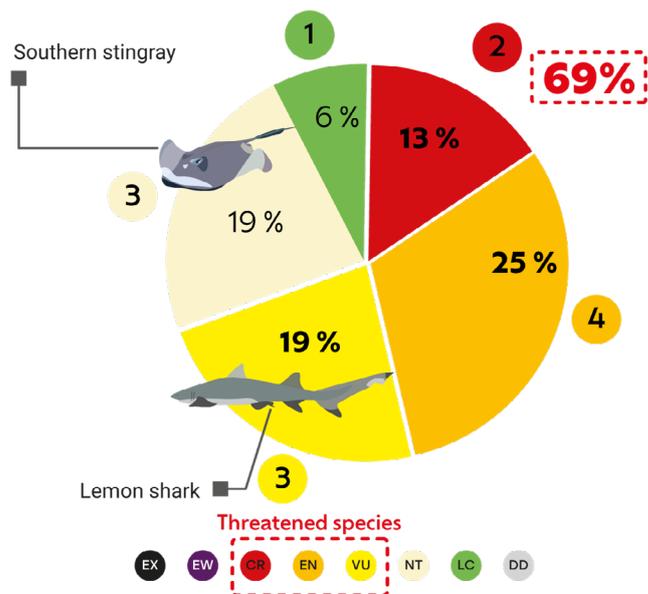_In the red box, the proportion of threatened species._

Nearly **70 % of the shark and ray species associated with coral reefs in Guadeloupe** (8 sharks, 5 rays) are threatened. **2** species of hammerhead sharks are **listed as « Critically Endangered ». Half** of the « Endangered » **species** are **rays**, while the **3** « **Vulnerable** » **species** are **sharks,** including the *Lemon Shark*. Finally, **two of the three** « **Near Threatened** » **species are rays**, such as the *Southern stingray*, which is common in Guadeloupean waters.

Human activities are the main cause of this group's worldwide decline, including fishing, bycatch, habitat destruction (nurseries in particular) and overfishing of prey essential to sharks.

Among other coral reef species in Guadeloupe, **fish, mollusks and crustaceans** are mostly classified as « **Least Concern** », suggesting that, overall, these species are widespread and abundant. Although risk of extinction for these species is low at global level, they may be locally threatened. Locally, **some species suffer from intensive exploitation**, such as queen conch, white sea urchins, lobsters and parrotfish, whose populations are declining.
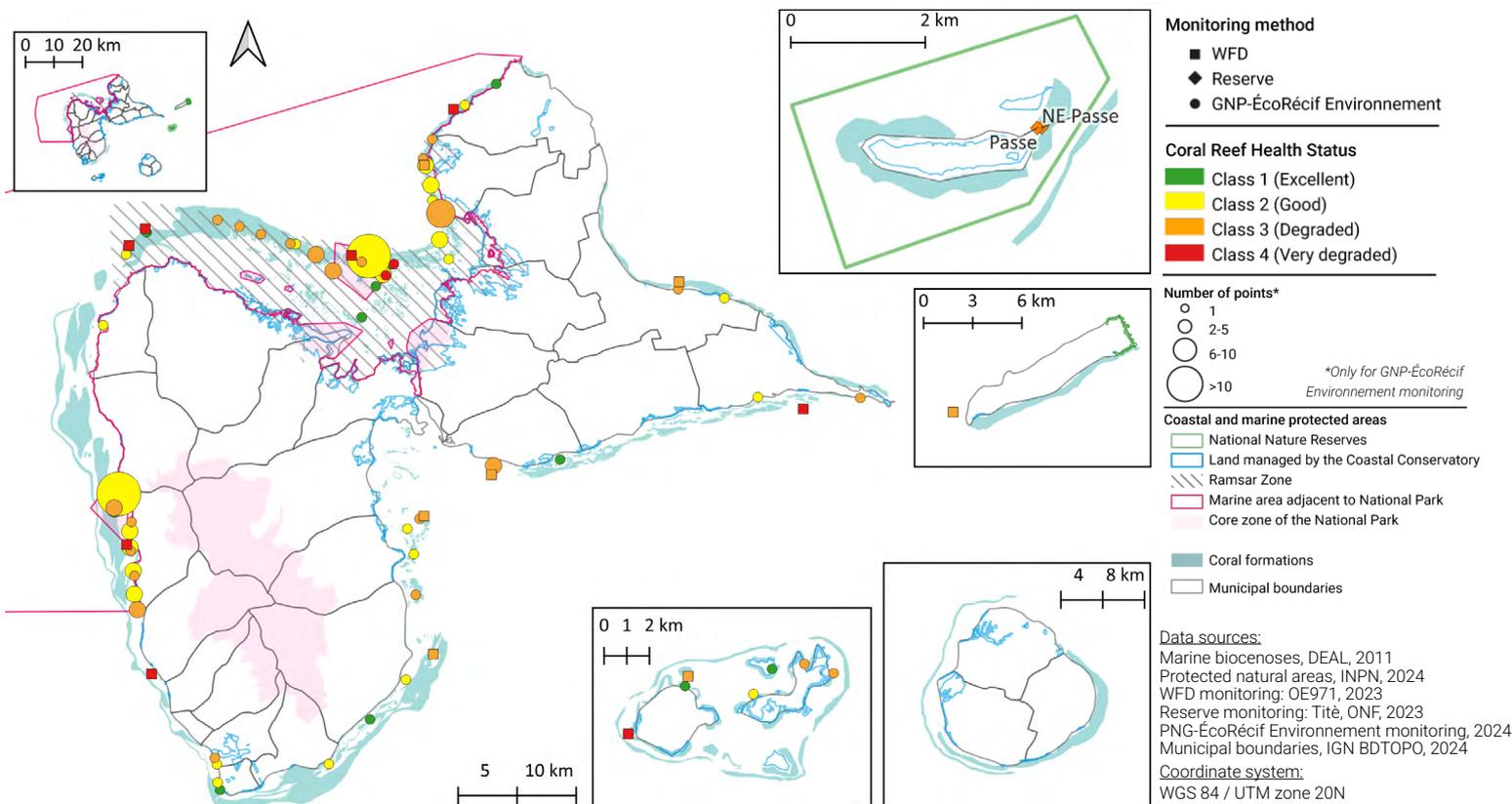

Sharks and rays
Out of a total of **13** species assessed

Southern stingray

Lemon shark

Threatened species

EX EW CR EN VU NT LC DD

▲ **Figure 7:** Conservation status of sharks and rays that can be found in the coral reefs of Guadeloupe, assessed on the IUCN Red List (2020-2021).
In the circles, the number of species corresponding to each category. In the red box, the proportion of threatened species

6. Coral reef health status

Monitoring method
■ WFD
◆ Reserve
● GNP-ÉcoRécif Environnement

Coral Reef Health Status
■ Class 1 (Excellent)
■ Class 2 (Good)
■ Class 3 (Degraded)
■ Class 4 (Very degraded)

Number of points*
○ 1
○ 2-5
○ 6-10
○ >10
Only for GNP-ÉcoRécif Environnement monitoring

Coastal and marine protected areas
National Nature Reserves
Land managed by the Coastal Conservatory
Ramsar Zone
Marine area adjacent to National Park
Core zone of the National Park

Coral formations
Municipal boundaries

Data sources:
Marine biocenoses, DEAL, 2011
Protected natural areas, INPN, 2024
WFD monitoring: OE971, 2023
Reserve monitoring: Titè, ONF, 2023
PNG-ÉcoRécif Environnement monitoring, 2024
Municipal boundaries, IGN BDTOPO, 2024
Coordinate system:
WGS 84 / UTM zone 20N

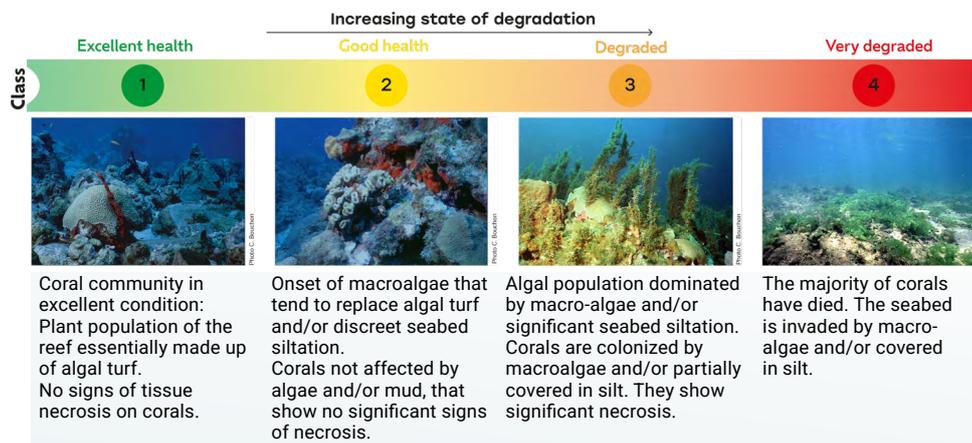▲ **Figure 8:** Map showing health status of coral reefs: GNP-EcoRécif Environnement monitoring (134 stations, Guadeloupe National Park (GNP), ÉcoRécif Environnement, 2023-2024), Water Framework Directive (WFD) monitoring (15 stations, Guadeloupe Water Office (OE971), 2023) and monitoring of the Petite Terre Islands National Nature Reserve (2 stations, National Forestry Office (ONF), Titè association, 2023).

Findings show that **11% of the sampled coral communities are very healthy, 52% are healthy but cohabit with macroalgae, 30% are strongly colonised by macroalgae** and/or partially covered by sediments, and **7% of the sampled sites are highly degraded.**

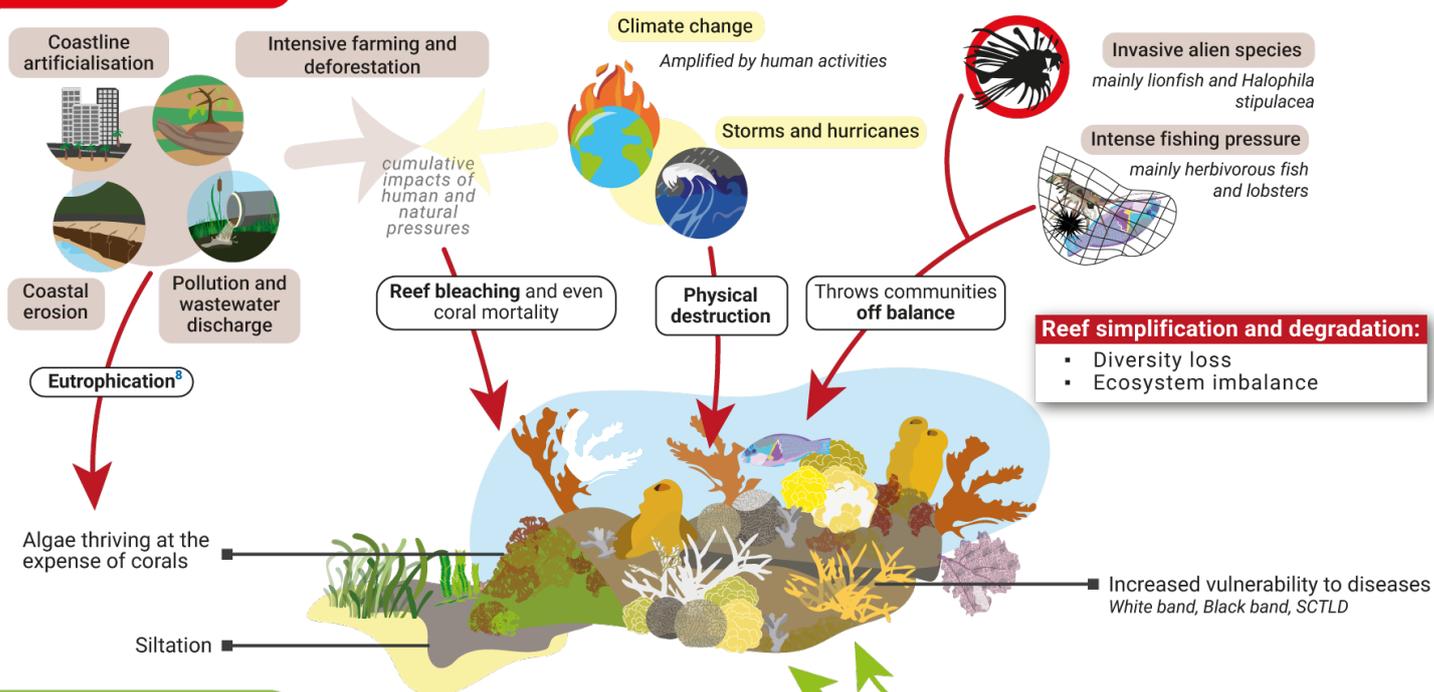Overall, **89% of the sampled reefs show signs of degradation.** Across the territory, coral communities have experienced significant decline since the 80s *(IFRECOR, 2021)*.

Increasing state of degradation

	Excellent health	Good health	Degraded	Very degraded
Class	1	2	3	4

Coral community in excellent condition: Plant population of the reef essentially made up of algal turf. No signs of tissue necrosis on corals.

Onset of macroalgae that tend to replace algal turf and/or discreet seabed siltation. Corals not affected by algae and/or mud, that show no significant signs of necrosis.

Algal population dominated by macro-algae and/or significant seabed siltation. Corals are colonized by macroalgae and/or partially covered in silt. They show significant necrosis.

The majority of corals have died. The seabed is invaded by macro-algae and/or covered in silt.

▲ **Figure 9:** Visual estimation and classification of coral reef health status.
Source : Bouchon et *al.* 2004.

⟶ **Most coral colonies suffer from the discharge of polluted waters, which degrades coastal water quality and the health of coral reefs.**
Dysfunctional sanitation systems are one of the main causes of reef decline in the archipelago.

Threats

Coastline artificialisation

Intensive farming and deforestation

Climate change
Amplified by human activities

Invasive alien species
mainly lionfish and Halophila stipulacea

Storms and hurricanes

Intense fishing pressure
mainly herbivorous fish and lobsters

cumulative impacts of human and natural pressures

Coastal erosion

Pollution and wastewater discharge

Reef bleaching and even coral mortality

Physical destruction

Throws communities **off balance**

Reef simplification and degradation:
- Diversity loss
- Ecosystem imbalance

Eutrophication[8]

Algae thriving at the expense of corals

Increased vulnerability to diseases
White band, Black band, SCTLD

Siltation

Solutions

Conservation tools

Species
- Ministerial decree:
  - 16 coral species protected
- International agreements:
  - CITES
  - Annexes II and III of the SPAW Protocol

Areas
- **Guadeloupe National Park**
  - Core marine area: 5,000 ha
  - Adjacent marine area: 132,500 ha
  - Including Grand Cul-de-Sac Marin and many islets
- **Petite Terre Islands Reserve**
  - Marine area: 842 ha
- **AGOA Sanctuary**
  - Protection of marine mammals and their habitats

Improving sanitation systems
Bringing collective and non-collective networks into compliance

Strengthening the monitoring effort
Reducing inequalities in monitoring between territories

Promoting the natural regeneration of coastal marine ecosystems
Promoting the resilience of degraded reefs

Developing ecotourism
Respect for the environment and local cultures

[8] A build-up of nutrients (nitrates, phosphates) in the environment, resulting in a proliferation of algae whose decomposition depletes it of oxygen and degrades water quality.

▲ **Figure 10:** Threats to coral reefs, and solutions. *The red arrows indicate threats and the green arrows, solutions to be implemented.*

ⓘ ABOUT THE INDICATOR

▶ Calculation method

Cartographic representation

• The "coral formations" layer includes the "corals and other benthic populations" data, whether or not associated with seagrass beds and algae beds, produced by the DEAL of Guadeloupe The areas were calculated from GIS data.

• For better readability, the PNG-EcoReef Environment monitoring points located less than 500m from each other and that belonged to the same class were grouped into a single point (centroid). The size of circles on the map reflects the number of points grouped together (*fig. 8*).

Species conservation status

• The proportions of species by Red List category (IUCN) were calculated according to the species found in the coral reefs of Guadeloupe and assessed, on the IUCN Red List.

$$\text{Share of threatened species} = \frac{\text{Number of species facing extinction(CR+EN+VU)}}{\text{Total number of species assessed}} \times 100$$

Coral reefs health status

• For the WFD and Réserve des Iles de Petite Terre monitoring, the average health status of 6 transects was calculated at each station. For each average, if the decimal is <0.5, the station takes the lower grade; if the decimal ≥0.5, the station takes the higher grade (downgrading category).

▶ Limitations

Currently, there is no specific Red List for the marine wildlife of Guadeloupe, except for turtles and marine mammals. The data presented comes from the global IUCN Red List updated in 2024. A revision is planned in 2025 for reef fishes and in 2026 for corals (Y. Bouchon-Navaro, *pers. comm.,* 2024).

Different assessment methodologies depending on the monitoring process:

• WFD and Petite Terre reserve: Assessment based on the recruitment of young corals and the ratio between areas of "algal turf" (healthy reefs) and macroalgae (degraded reefs), with a 5-tiered scale (from "Excellent" to "Very degraded "). To harmonize data across monitoring processes, tiers 4 and 5 of the WFD monitoring process are grouped into a single category: "very degraded".

• Mapping the health status of reefs by the National Park – EcoRécif Environnement: Based on macroalgae abundance and sedimentation rate, with a 4-tier scale (from "very good" to "very degraded").

• GCRMN: Data from the four sites in Guadeloupe result from quantitative monitoring of reef benthic communities on permanent transects.

▶ Source data

Monitoring networks:
2020 IFRECOR report on the state of coral reef health
Producers of monitoring data:
Water Framework Directive (Office de l'Eau Guadeloupe, OE971) : CREOCEAN (2023) / Petite Terre National Nature Reserve (ONF, Titè) : CREOCEAN (2023) / Guadeloupe National park (GNP) and Écorécif Environnement : Léger N., Mège S., Bouchon-Navaro Y., Baltide D., Bouchon C., 2024.Rapid assessment of the health status of coral communities in Guadeloupe Island (Lesser Antilles). *Com. 77th GCFI Congress, 4-8 November 2024, Guadeloupe.*

Biodiversity data : TAXREF and INPN (2024)
INPN : Data Protected natural areas (2024), Species of Guadeloupe (fauna & flora), IUCN Red List of Threatened species from INPN, version (2023.1) downloaded on 26/06/2024.

▶ References

Bouchon, C., Bouchon-Navaro, Y., Brugneaux, S., Mazeas, F. (2002). L'état des récifs coralliens dans les Antilles françaises. IFRECOR.

Bouchon C., Bouchon-Navaro Y., Louis M. (2004). Critères d'évaluation de la dégradation des communautés coralliennes dans la Caraïbe. *Revue d'Ecologie (terre et vie)*, 59 : 113-121.

Bouchon C., Bouchon-Navaro Y., Louis M., Mazeas F., Marechal J-P., Portillo P., Tregarot E. (2014). French Antilles. Pp 233-237. In: Status and trends of Caribbean coral reefs: 1970-1972. Jackson J.B.C., Donovan M.K., Cramer K.L., Lam V. (eds) IUCN publications, 243 pp.

FFEM et Océanopolis (2021) – Les écosystèmes marins – Les coraux, bâtisseurs de récifs. Fonds Français pour l'Environnement Mondial, Paris et Océanopolis, Brest pp. 72

Ifrecor. (2021). Etat de santé des récifs coralliens, herbiers marins et mangroves des outre-mer français. Bilan 2020 (Chapitre Guadeloupe, pp. 85-107).

Université des Antilles et de la Guyane, Parc National de Guadeloupe, & Agence des aires marines protégées. (2012). Analyse régionale – Guadeloupe - Synthèse des connaissances.

▶ Theoretical update frequency

Every 5 to 6 years depending on IFRECOR reports updates.

Editors

• Mrs. Lisel Loschenkohl (ORBIG's Data Valorization and Production Officer)
• Catherine Hermant, PhD (Head of the Regional Observatory of Biodiversity of the Guadeloupe Islands (ORBIG))
• Translation: Sally Stainier, PhD (URURIMI)

🌐 USEFUL LINKS

IFRECOR Guadeloupe Committee: https://ifrecor.fr/comite-guadeloupe/
Changes in coral reef condition: https://naturefrance.fr/indicateurs/evolution-de-letat-des-recifs-coralliens
Guadeloupe National Park: https://www.guadeloupe-parcnational.fr/fr/des-connaissances/patrimoines-naturels/les-milieux/milieux-marins/recifs-coralliens
Department of Environment, Planning, and Housing (DEAL): https://www.guadeloupe.developpement-durable.gouv.fr/reglementation-et-especes-protegees-r658.html
INPN Biodiversity of Guadeloupe: https://inpn.mnhn.fr/collTerr/biodiversity/TER971
Overseas Biodiversity Counter: https://biodiversite-outre-mer.fr/indicateurs/recifs-coralliens

Associated partners

IFRECOR · Parc national de la Guadeloupe · ÉcoRécif Environnement · PRÉFET DE LA RÉGION GUADELOUPE - Direction de l'Environnement, de l'Aménagement et du Logement · Réserves Naturelles LA DÉSIRADE ILES DE PETITE TERRE - ASSOCIATION Titè - Office National des Forêts · Office de l'Eau GUADELOUPE · GUADELOUPE PORT CARAÏBES L'Excellence Européenne · OFB OFFICE FRANÇAIS DE LA BIODIVERSITÉ

Graphic design : Julia Bos - Ecodyssée