



## Warming of Great Barrier Reef Waters

[Source: IE](#)

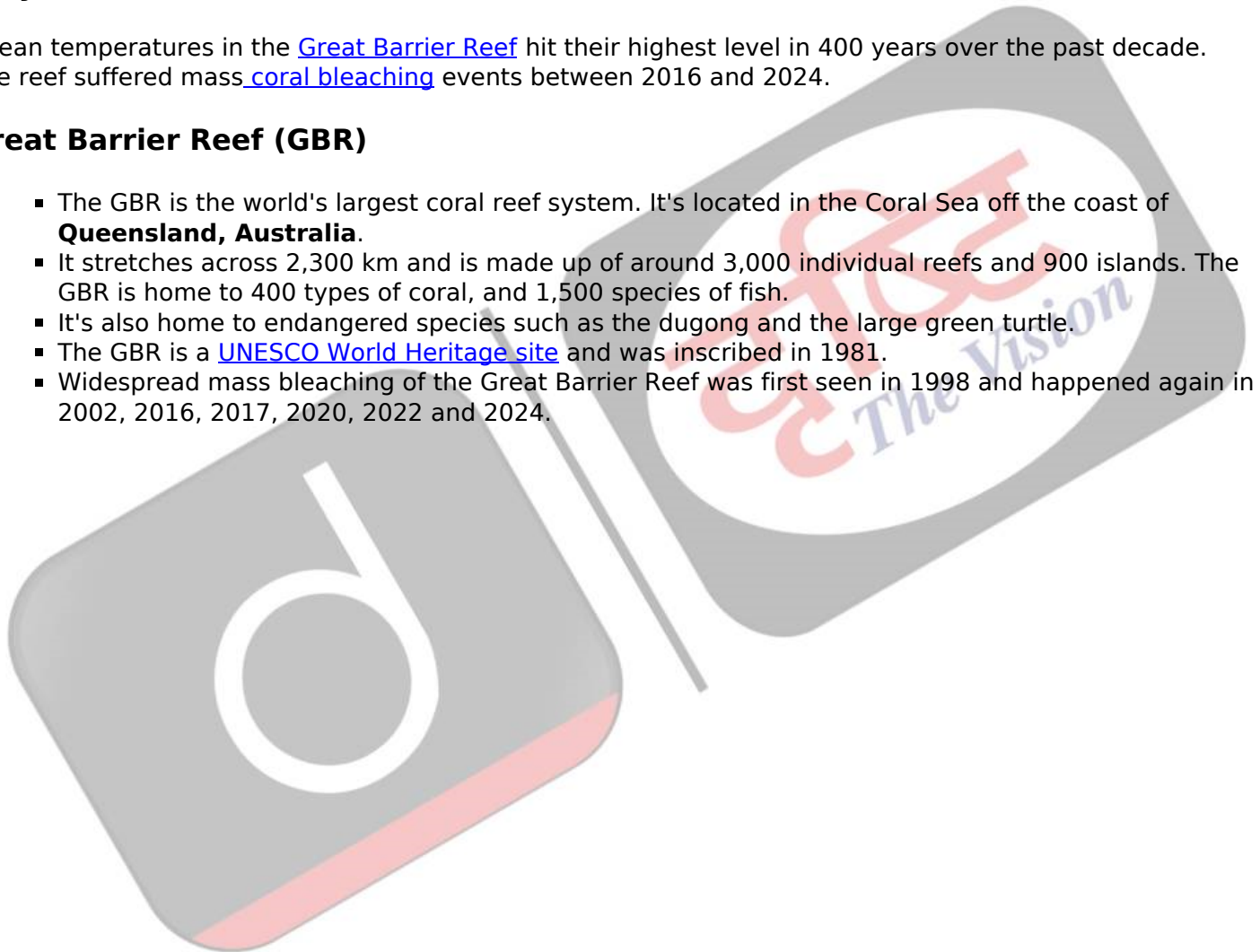
### Why in News?

Ocean temperatures in the [Great Barrier Reef](#) hit their highest level in 400 years over the past decade. The reef suffered mass [coral bleaching](#) events between 2016 and 2024.

### Great Barrier Reef (GBR)

- The GBR is the world's largest coral reef system. It's located in the Coral Sea off the coast of **Queensland, Australia**.
- It stretches across 2,300 km and is made up of around 3,000 individual reefs and 900 islands. The GBR is home to 400 types of coral, and 1,500 species of fish.
- It's also home to endangered species such as the dugong and the large green turtle.
- The GBR is a [UNESCO World Heritage site](#) and was inscribed in 1981.
- Widespread mass bleaching of the Great Barrier Reef was first seen in 1998 and happened again in 2002, 2016, 2017, 2020, 2022 and 2024.

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# Coral Reefs

(Rainforests of the seas)



## About

- ✦ **Large underwater structures** – made of skeletons of **colonial marine invertebrates** ‘coral’ – individually called **polyp**
- ✦ **Symbiotic** Relationship with **algae** ‘**zooxanthellae**’ (responsible for beautiful colours of corals)
- ✦ Support over 25% of marine biodiversity

## Hard Corals vs Soft Corals

- ✦ **Hard Corals** - Rigid skeleton **made of  $\text{CaCO}_3$**  - **reef-building** corals
- ✦ **Soft Corals** - Non reef-building

## Great Barrier Reef (Australia)

- ✦ Largest Coral Reef in the World
- ✦ World Heritage Site (1981)
- ✦ Endures Mass Coral Bleaching



## Corals in India

- ✦ Present in the areas of Gulf of Kutch, Gulf of Mannar, Andaman & Nicobar, Lakshadweep Islands and Malvan



## Significance

- ✦ Coral reefs **protect coastlines from storms/erosion**, provide jobs, offer opportunities for recreation
- ✦ Source of **food/medicines**

## Threats

- ✦ **Natural:** Temperature, Sediment Deposition, Salinity, pH, etc.
- ✦ **Anthropogenic:** Mining, Bottom Fishing, Tourism, pollution, etc.

## Coral Bleaching

- ✦ Corals under stress - expel algae – thus turning white (bleached)
- ✦ Bleached corals - not dead – but, more risk of starvation/disease



## Initiatives to Protect Corals

### Technology

- ✦ **Cyromesh:** Storage of the coral larvae at (-196°C) - Can be later reintroduced to the wild
- ✦ **Biorock:** Creating artificial reefs on which coral can grow rapidly



### Global

- ✦ International Coral Reef Initiative
- ✦ The Global Coral Reef R&D Accelerator Platform

### Indian

National Coastal Mission Programme

## What are the Research Findings?

- **Coral Bleaching:** Aerial surveys of more than 300 reefs along **Australia's northeast coast** revealed bleaching in shallow waters, affecting two-thirds of the reef.
- **Rising Threats:** Even if global warming is kept under the [Paris Agreement's goal](#), 70% to 90% of corals across the globe could be threatened.
- **Less Diversity:** [Coral reefs](#) have been evolving over the past quarter century in response to bleaching events. As more **heat-tolerant coral** replaces the less heat-tolerant species, there is a real concern about the expected extreme loss in the number of species and reduction in area that the world's largest reef covers.

## What are Coral Reefs?

- **About:**
  - Coral reefs are [marine ecosystems](#) primarily composed of coral polyps that form [symbiotic](#) relationships with [zooxanthellae](#), a photosynthetic [algae](#).
  - The **zooxanthellae** provide corals with **nutrients** and **oxygen**, while corals offer **shelter**. This [mutualism](#) is vital for the health and survival of coral reefecosystems.
- **Types:**
  - **Hydrocorals (Fire Corals):** They are **reef-building** hydroids that have a **hard calcareous exoskeleton** and stinging cells that can cause a burning sensation when touched.
  - **Octocorals (Soft Corals):** It includes sea fans and sea whips, which grow more like **fleshy plants** and do not form calcium carbonate skeletal structures.
  - **Antipatharians (Black Corals):** They are a type of '**soft**' coral recognised by their **jet-black or dark brown chitin skeletons**.
- **Geographical Extent:**
  - **Corals** can be found throughout the world's oceans, in both **shallow** and **deep water**. However, the reef-building corals that rely on a symbiotic relationship with algae need **shallow, clear water**, allowing light penetration for photosynthesis.
    - **Stony corals** also require tropical or subtropical temperatures, which exist in a band between **30° north** and **south latitudes**.
  - The major coral reef formations in India are **Gulf of Mannar, Palk Bay, Gulf of Kachchh, Andaman and Nicobar Islands** and **Lakshadweep Islands**.
- **Importance:**
  - They **cover only 1%** of the world's oceans but provide **habitat** for at **least 25%** of the world's marine species.
  - Coral reefs are valuable for medicinal research, with many drugs being developed from reef organisms to treat **cancer, arthritis, infections**, and other diseases.
  - Coral reefs **protect shorelines** by mitigating the impact of waves, storms, and floods and contribute to [beach formation](#), with much of the sand on nearby beaches made from broken-down coral skeletons.
  - Coral reefs are also **home** to important filter feeders, like **sponges**, that filter toxins and contaminants out of the oceans, and support large amounts of **plant life** that take in carbon dioxide and release oxygen.
- **Coral Bleaching:**
  - When corals are **stressed** due to factors like [increased ocean temperature](#) or pollution, the algae **leave** the coral's tissue.
  - Without algae, corals **lose their color**, turning white or very pale, and become more vulnerable to disease.
  - The loss of algae disrupts the coral's food supply and leads to coral bleaching.

# CORAL BLEACHING

Have you ever wondered how a coral becomes bleached?

## HEALTHY CORAL

1 Coral and algae depend on each other to survive.



Corals have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are the coral's primary food source and give them their color.

## STRESSED CORAL

2 If stressed, algae leaves the coral.



When the symbiotic relationship becomes stressed due to increased ocean temperature or pollution, the algae leave the coral's tissue.

## BLEACHED CORAL

3 Coral is left bleached and vulnerable.



Without the algae, the coral loses its major source of food, turns white or very pale, and is more susceptible to disease.

## WHAT CAUSES CORAL BLEACHING?



### Change in ocean temperature

Increased ocean temperature caused by climate change is the leading cause of coral bleaching.



### Runoff and pollution

Storm generated precipitation can rapidly dilute ocean water and runoff can carry pollutants — these can bleach near-shore corals.



### Overexposure to sunlight

When temperatures are high, high solar irradiance contributes to bleaching in shallow-water corals.



### Extreme low tides

Exposure to the air during extreme low tides can cause bleaching in shallow corals.



## UPSC Civil Services Examination, Previous Year Question (PYQ)

*Prelims:*

**Q.Consider the following statements: (2018)**

1. Most of the world's coral reefs are in tropical waters.
2. More than one-third of the world's coral reefs are located in the territories of Australia, Indonesia and Philippines.
3. Coral reefs host far more number of animal phyla than those hosted by tropical rainforests.

**Which of the statements given above is/are correct?**

- (a) 1 and 2 only  
(b) 3 only  
(c) 1 and 3 only  
(d) 1, 2 and 3

**Ans: (d)**

**Q.Which of the following have coral reefs? (2014)**

1. Andaman and Nicobar Islands
2. Gulf of Kachchh
3. Gulf of Mannar
4. Sunderbans

**Select the correct answer using the code given below:**

**(a)** 1, 2 and 3 only

**(b)** 2 and 4 only

**(c)** 1 and 3 only

**(d)** 1, 2, 3 and 4

**Ans: (a)**

PDF Refernece URL: <https://www.drishtias.com/printpdf/warming-of-great-barrier-reef-waters>

