Coral Reef: Fringing Reef, Barrier Reef & Atoll

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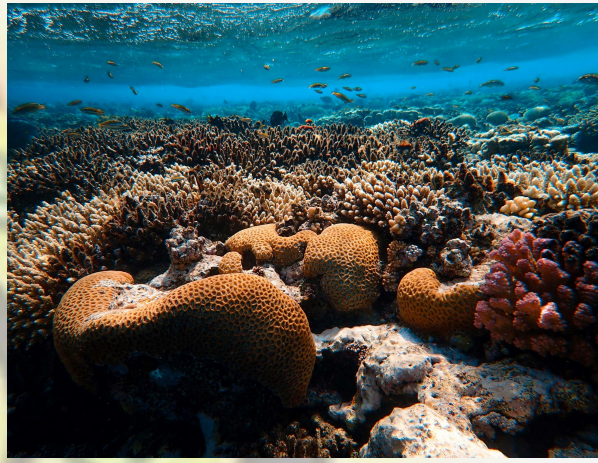

A **coral reef** is an underwater ecosystem characterized by reef-building **corals**. Coral reefs are some of the oldest and most dynamic ecosystems on Earth, crucial for the health of our oceans. act as natural barriers, protecting coastlines from erosion and safeguarding marine life.

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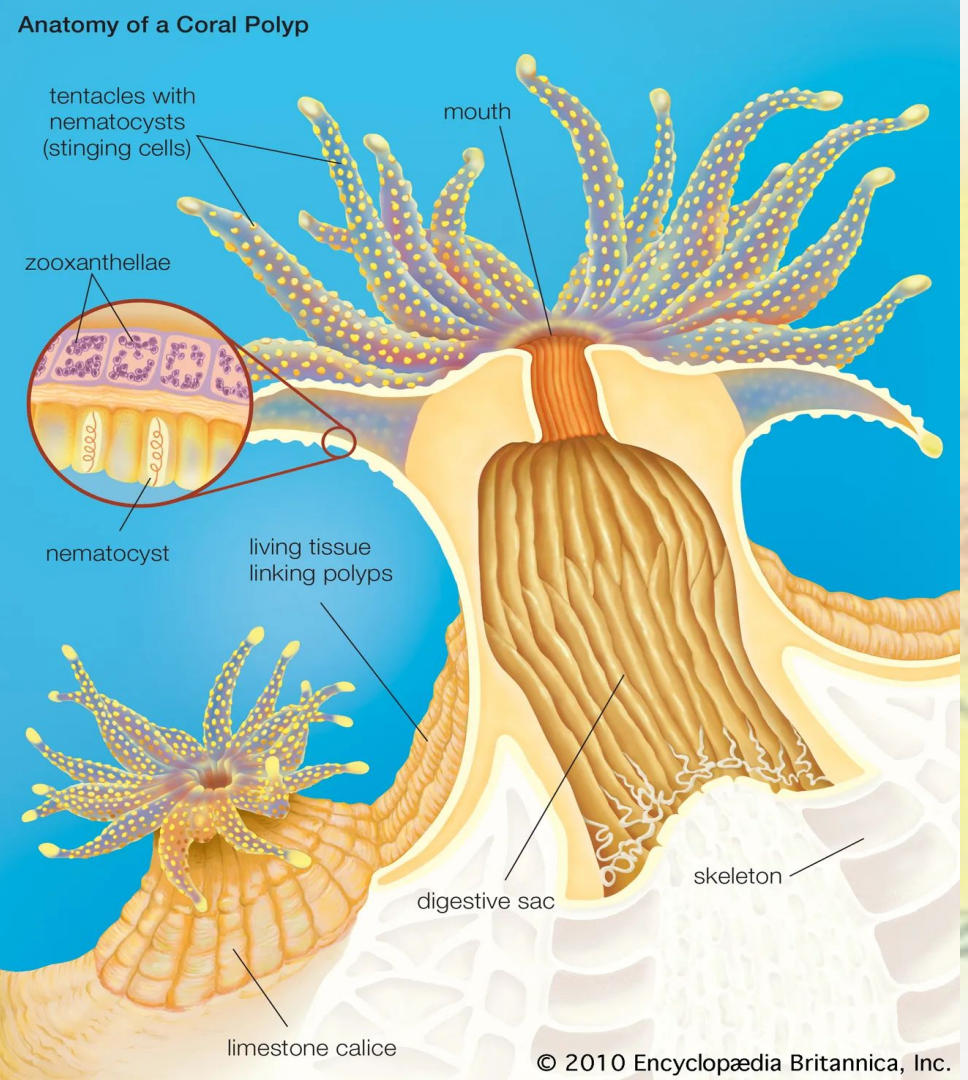
Formation of Coral Reefs:

- Coral polyps: Tiny sea anemones that build the reef's foundation.
- Symbiosis: Corals have a mutually beneficial relationship with algae (zooxanthellae), which provide energy through photosynthesis.
- Attachment: Free-floating coral larvae attach to hard surfaces near coastlines.
- Building Up: The coral polyps extract calcium from seawater to create skeletons. As polyps die, their skeletons become the base for new growth.
- Reef Formation: Over time, layers of skeletons accumulate and solidify, forming coral reefs.

Estd. 1993

1. A **symbiotic** relationship is one in which organisms, people, or things exist together in a way that benefits them all. Symbiosis is a relationship or interaction between two or more species that share a common habitat.
2. **Mutualism, Commensalism, and Parasitism** are the three types of behaviors seen in symbiotic interactions.

- **Mutualism**: Mutualism occurs when both creatures involved benefit from each other.
- **Commensalism**: Only one organism benefits from commensalism, whereas the other is neither benefited nor injured.
- **Parasitism**: Parasitic relationships benefit one creature while harming the other.



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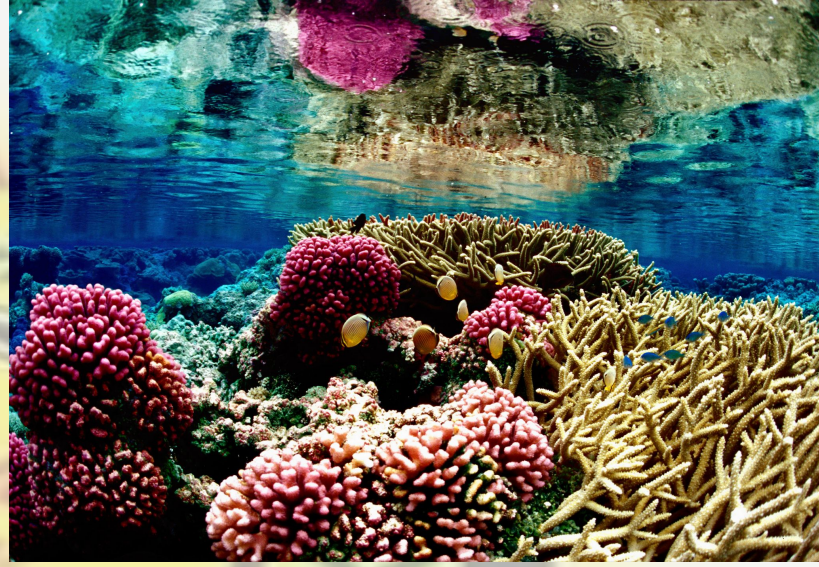
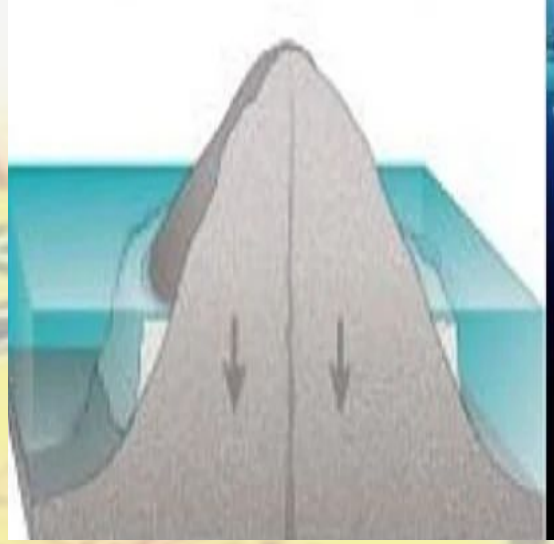
Corals and Zooxanthellae:



- **Association for High Productivity:**
  - Coral reefs are often called **'the Tropical Rainforests of the Oceans'** due to their exceptional productivity and biodiversity.
  - Diverse marine life, including invertebrates, vertebrates, and plants, closely associated with corals, fostering resource coupling and recycling.
- **Scleractinian Corals' Skeletons:** Scleractinian corals, belonging to Phylum Cnidaria, construct skeletons using calcium carbonate extracted from the water
- **Zooxanthellae - Phylum Dinoflagellata:**
  - Zooxanthellae are autotrophic microalgae belonging to Phylum Dinoflagellata.
  - The coral (Phylum Cnidaria) and Zooxanthellae (Phylum Dinoflagellata) share a mutually beneficial association, contributing to the health and vitality of coral reefs.

Types of coral reefs in India

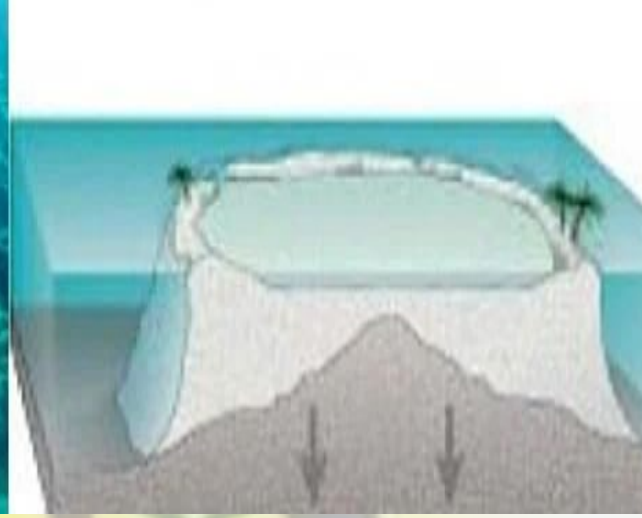
- Fringing Reefs:
  - Location: Grow directly from a shore, very close to land and forms a shallow lagoon known as **Boat Channel**
  - Characteristics: Often form a shallow lagoon between the beach and the main reef.
  - Shape: Runs as a narrow belt (1-2 km wide).
  - Seaward Slope: Slopes steeply into the deep sea on the seaward side.
  - Commonality: Most common type of coral reef globally.
  - Examples: New Hebrides Society islands, southern coast of Florida.

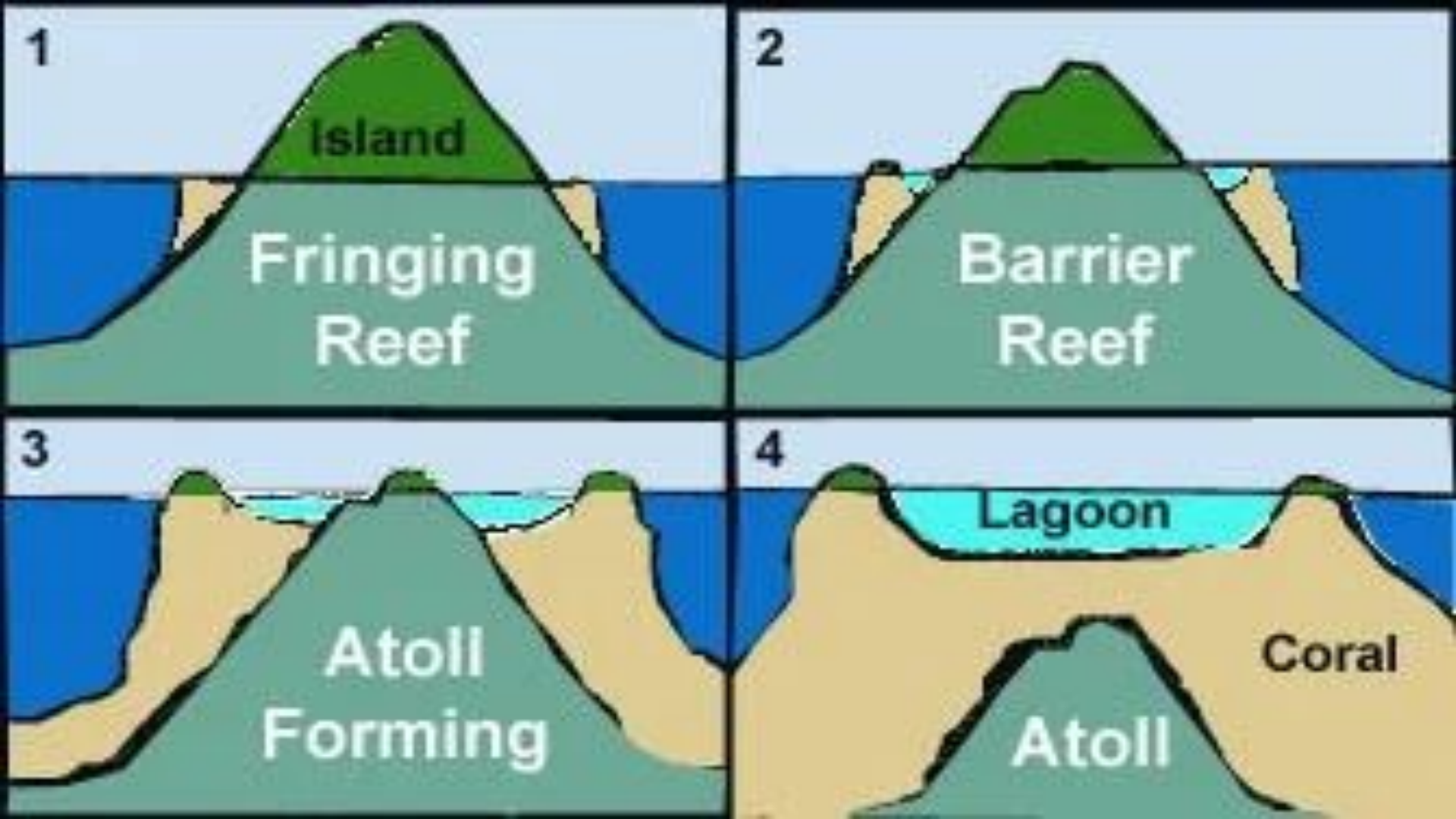


- Barrier Reefs:
  - Location: Extensive linear reef complexes parallel to a shore, separated by a lagoon.
  - Size: Largest in size among reef types, running for hundreds of kilometers and several kilometers wide.
  - Shape: Extends as a broken, irregular ring around the coast or an island.
  - Rarity: Less common than fringing reefs or atolls.
  - Example: Great Barrier Reef (GBR) off the NE coast of Australia.
    - Note: GBR is a complex consisting of many reefs, not a single reef.

A lagoon is a shallow body of water protected from the ocean by sandbars, barrier islands, or coral reefs.

- Atolls:
  - Structure: Circular (annular) oceanic reef system surrounding a large central lagoon.
  - Lagoon Depth: Lagoon has a depth of 80-150 meters.
  - Channels: May be joined with seawater through channels cutting across the reef.
  - Formation Factors: Often formed at great distances from deep-sea platforms, facilitated by submarine features.
  - Forms:
    - True Atoll: Circular reef enclosing a lagoon with no island.
    - Atoll with Island: Surrounding a lagoon with an island.
    - Coral/Atoll Island: Formed by erosion and deposition of waves, with island crowns on atoll reefs.
  - More common in the Pacific, especially in French Polynesia, Caroline and Marshall Islands, Micronesia, and Cook Islands.
  - Indian Ocean Examples: Maldives, Chagos island groups, Seychelles, Cocos Island group, and Lakshadweep Islands.




1
Island
Fringing
Reef
2
Barrier
Reef
3
Atoll
Forming
4
Lagoon
Coral
Atoll

Ideal Conditions for Coral Growth:

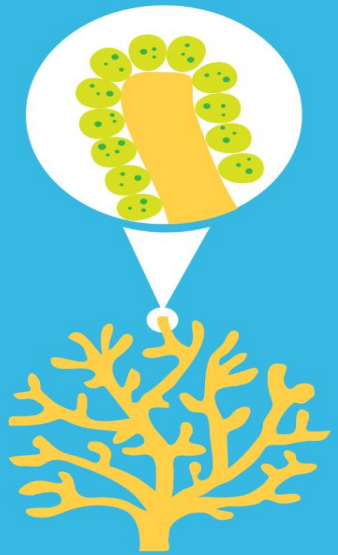
1. Stable Climatic Conditions:
   - Corals flourish in regions with prolonged climatic stability.
   - Quick and drastic climate changes adversely affect coral health.
2. Perpetually Warm Waters:
   - Corals thrive in tropical waters between **30°N and 30°S latitudes.**
   - **Ideal water temperature is around 20°C,** with minimal diurnal and annual temperature variations.
   - Absence on the west coast of tropical continents is attributed to cold ocean currents, as corals prefer warm waters.
3. Shallow Water:
   - Corals require ample sunlight for survival.
   - Optimal growth occurs at depths of 45m to 55m below the sea surface.
4. Clear Salt Water:
   - Clear salt water is conducive to coral growth.
   - Both freshwater and highly saline water are detrimental to corals.
5. Abundant Plankton:
   - Adequate plankton, especially phytoplankton, is essential for coral growth.
   - Corals thrive on the seaward side where plankton is more abundant.
6. Minimal Pollution:
   - Corals are fragile and highly susceptible to pollution.
   - Even slight increases in marine pollution, a consequence of climate change, can have catastrophic effects on coral reefs.

CORAL BLEACHING

Have you ever wondered how a coral becomes bleached?

HEALTHY CORAL

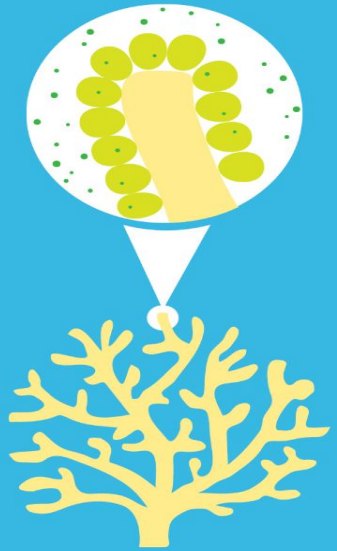
1 Coral and algae depend on each other to survive.



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.

NOAA's Coral Reef Conservation Program
http://coralreef.noaa.gov/

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What is Coral Bleaching?

- Coral bleaching happens when corals expel their symbiotic algae (zooxanthellae) due to stress. This algae is essential for coral health and gives them color.
- Bleached corals appear white, losing 60-90% of their algae and much of its photosynthetic pigment.

Causes of Coral Bleaching

- **Human Impact:** Overfishing, pollution, and increased sedimentation.
- **Natural Causes:** Extreme temperatures, storms, El Nino events, and disease outbreaks.
- **Temperature Extremes:** Both high and low temperatures stress corals. Prolonged heat is the most common cause of widespread bleaching.
- **Ocean Acidification:** Combined with rising temperatures, acidification reduces corals' ability to build their skeletons, making them more vulnerable to bleaching.

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- **Sunlight and UV Radiation:** Calm, clear water with reduced wind speeds can create conditions where increased heat and UV radiation cause coral bleaching.
- **Exposure to Air:** Extreme low tides or tectonic events that expose reef corals to air can trigger bleaching from temperature stress, sunlight, and changes in salinity.
- **Freshwater Dilution:** Storms and heavy rainfall can dilute seawater, causing stress and sometimes bleaching in nearshore reefs.
- **Inorganic Nutrients:** While increased nutrients typically boost algae growth in corals, extreme levels can harm corals and worsen their vulnerability.
- **Pollution:** High levels of chemicals like herbicides, oil, and copper can trigger bleaching.
- **Disease:** Some diseases cause a whitening effect, but this differs from typical bleaching as the coral tissue dies.

The Bleaching Process

- Stressed corals may recover if conditions improve quickly.
- Prolonged stress without algae recovery leads to coral death.

Additional Notes

- Widespread bleaching events became common in the 1980s, coinciding with rising ocean temperatures.
- Some research suggests that corals consistently exposed to low stress levels might develop a degree of resistance to bleaching.
- The ongoing third global coral bleaching event (2015-16) is the longest and most severe, driven by the strongest El Niño on record.

- Coastline Overview: India boasts a coastline of approximately 7,517 km, with 6,100 km constituting the mainland coastline.
- Types of Coral Reefs: The three main types of coral reefs found in India are **fringing reefs, barrier reefs, and atolls.**
- Coral reefs are widespread across various regions in India, including:
    - Gulf of Kutch
    - Gulf of Mannar
    - Palk Bay
    - Andaman & Nicobar Islands
    - Lakshadweep Islands
- Noteworthy Locations:
    - Gulf of Kutch hosts some of the world's most northerly reefs.
    - Patches of coral reefs identified in Ratnagiri, Malvan, Redi, south Bombay, and Gaveshani Bank (west of Mangalore).
- Shore-Parallel Corals: Quilon near the Kerala coast to Enayem in Tamil Nadu features corals running parallel to the shore.
- East Coast Abundance: Abundant coral presence observed on the east coast between Parangipettai (south of Cuddalore) and Pondicherry.
- Island Riches: Andaman and Nicobar Islands, along with Lakshadweep Islands, are notable for their thriving coral ecosystems.

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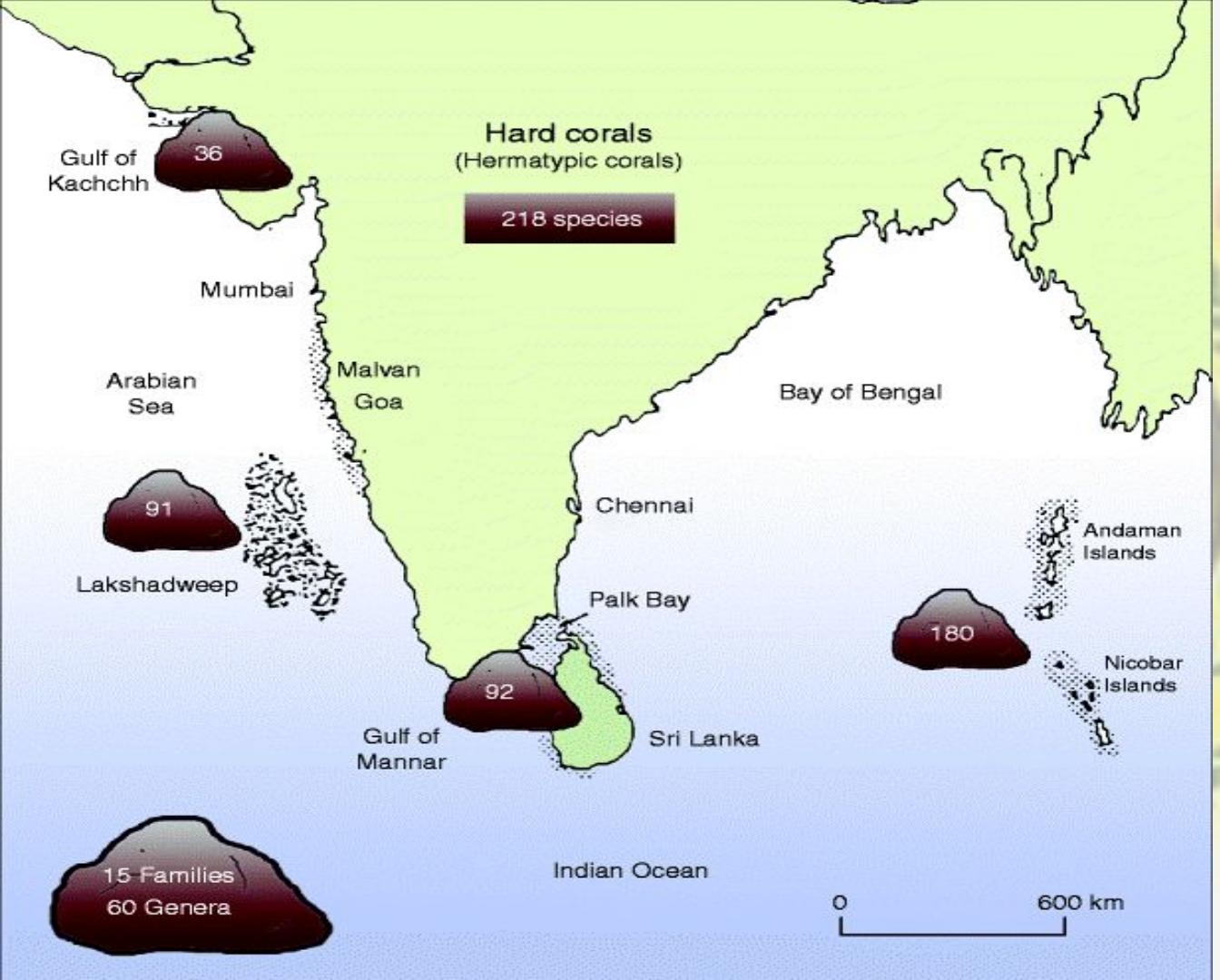

Laws Protecting Coral Reefs in India:

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Government Oversight:

- Ministry of Environment, Forest and Climate Change establishes guidelines and ensures enforcement of laws protecting coral reefs.
- State Wildlife departments manage coral protection in designated protected areas.

Coastal Regulation Zone (CRZ):

- Coastal Regulation Zone Act of 1991 safeguards marine resources.
- Coral reefs fall under CRZ1 category, prohibiting construction of hotels or resorts on coral reefs.
- Mining and quarrying of coral reefs restricted, except for scientific purposes in specific states.

Conservation Measures:

- Recognizes the vital role of coral reefs in sustaining marine life for over a million years.
- Urges strict enforcement of laws with penalties for non-compliance.
- Emphasizes the collective responsibility to protect coral reefs from erosion and degradation.

The largest barrier reef system in the world is found at

(a) East Australian Coast

(b) West Australian Coast

(c) North Australian Coast

(d) South Australian Coast

Which one among the following is ***not*** a coral reef island?

(a) Great Barrier Reef, Australia

(b) Rainbow Reef, Fiji

(c) Swaraj Island, India

(d) Kyushu Island, Japan

The **Great Barrier Reef** is the largest coral reef system in the world. The reef is located off the coast of **Queensland, Australia, in the Coral Sea.**

2. Which among the following are called Rainforests of the Ocean?

- Zooplanktons
- Corals
- Phytoplanktons
- Algae

Which of the following have coral reefs?

1. Andaman and Nicobar Islands

2. Gulf of Kachchh

3. Gulf of Mannar

4. Sunderbans

Select the correct answer using the code given below.

1. 1, 2 and 3 only
2. 2 and 4 only
3. 1 and 3 only
4. 1, 2, 3 and 4

What type of corals are found very close to the land and forms a shallow lagoon known as Boat Channel?

1. Atoll
2. Fringing Reef
3. Barrier Reef

Select the correct code from the options given below:

Coral reefs are *not* found in which one of the following regions ?

(a) **Lakshadweep Islands**

(b) **Gulf of Kachchh**

(c) **Gulf of Mannar**

(d) **Gulf of Cambay**

Which among the following is/are conditional for the formation of Coral Reefs?

1. The temperature of the water should be below 20°C.

2. Shallow water having a depth less than 50 m.

Select the correct code from the options given below:

Which among the following is most commonly found Coral Reef?

1. Fringing Reef

2. Barrier Reef

3. Atoll

Select the correct code from the options given below:

Q. **Consider the following statements :**

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