

Coral Reefs in India

[UPSC Notes]

What is a Coral Reef?

Coral Reefs are elementary sedimentary rocks located above the sea and oceanic bed of continental shelf and mid-oceanic ridges. These organic sedimentary rocks are formed on the platform of shelf and ridges through a combined process that includes sedimentation, compaction, cementation and solidification of the skeleton of coral polyps.

Coral Polyps are marine animals of tropical and subtropical seas and oceans (tiny fleshy sea anemones polyps) living in shallow water by maintaining a symbiotic relationship with the microscopic plant (algae)- Zooxanthellae. Zooxanthellae have photosynthetic capabilities, they provide food to corals, and in return, the polyps protect the zooxanthellae.

Since the evolution and development of Coral reefs are connected with the marine ecology of Coral Polyps, the marine ecology of coral polyps describes the conditions associated with the coral reefs.

- Coral reefs or massive undersea structures comprise the exoskeleton of aquatic invertebrates called corals, hence the name coral reefs.
- The corals that lead to the formation of reefs are called “hermatypic” (hard) corals. The hard corals extract calcium carbonate from the seawater to build a robust exoskeleton to shield their fragile, sack-like bodies.
- “Soft corals” are another distinct species of corals that do not support the creation of reefs in any manner. Instead, these flexible corals, which include fishes like sea fans and sea whips, frequently imitate plants and trees.

Types of Coral Reefs

Charles Darwin gave the classification of coral reefs in the year 1831. This classification is based on the reefs' nature, composition, and mode of occurrence. These are as follows:

Fringing Reef

The fringing reefs are mainly found near the coast of a volcanic island.

- This bordering reef may reach 200 meters into the sea from the coast.
- The active proliferating zone of fringing reefs is the reef front or the reef edge, which faces the ocean.
- There is a shallow water channel that is approximately 50-100 meters wide that runs between the coast and the reef front.
- Calcium carbonate, coral sand, mud, living and dead coral clusters (also called polyps), or the other organisms that make up most of this reef.

Examples of fringing reefs include the reef in South Florida, Mehetia Islands, and the Sakau islands in the New Hebrides.

Barrier reef

The barrier reef is situated at some stretch away from the coast.

- It spreads for up to 2000 kilometers and is 15 to 20 kilometers offshore.
- Lagoon, a deep body of water, divides the reef from the beach. It is safe to navigate across the lagoon.

The most suitable example of a barrier reef is the great barrier reef in Australia. It is also the largest barrier reef in the world.

Atoll

Atoll is often referred to as coral island or lagoon island.

- This reef encircles a lagoon in the shape of a horseshoe or ring.
- It is highly deep and is also very apt for navigation purposes.
- To allow for the free flow of water, the ring-shaped reef might be breached in a few areas.

The Pacific Ocean has more of these reefs than any other ocean.

Examples of atolls include the Atoll of Fiji, Trent Atoll in the Western Carolinas, Suvadiva in the Maldives (the largest atoll in the world), and Funafuti Atoll of Ellice.



Coral Reef Formation

Suitable environmental conditions required for Coral Reefs

1. **Hard Surface:** Presence of hard surface of sub-marine platform of the continental shelf or mid-oceanic ridges. This hard surface is a precondition for compaction, cementation, and solidification of unconsolidated skeletons of Coral Polyps.
2. **Depth:** The depth of the submarine platform should not be more than 80m from sea level as algae require a sufficient amount of sunlight for photosynthesis.
3. **Warm Oceanic water:** Coral Polyps are connected with warm oceanic water with a narrow range of temperatures. The temperature should be around 20 degrees. Thus, coral reefs are most extensive on the east coast of the continent but not in the case of India, as the East coast of India has a high amount of sediments in the water, and deposits prevent the growth of Coral Reefs.
4. **Sediment-free water:** Water should be relatively sediment free. The high amount of sediments in water is responsible for choking respiration of Coral Polyps and their early death. Because of this reason, Coral reefs dominate the west coast of India.

5. Nutrient Supply: The supply of nutrients ensures the healthy development of Polyps. So, the growth rate of Polyps is faster on the seaward side as oceanic waves support the supply of nutrients.
6. Mild salinity: Salinity ensures the healthy development of skeletons of Polyps. Coral Polyps extract calcium from seawater for their skeleton to protect their bodies. So, mild saltiness is also required for the growth of coral polyps.

Theories that describe and explain the evolution and development of coral reefs are broadly classified under three categories, briefly mentioned below.

1. Subsidence Theory (was propounded by Charles Darwin).
2. Glacial Control Theory (Daly gave it).
3. Standstill Theory (Murray proposed it).

However, two of these are more significant than the others. These theories are:

- Darwin's Subsidence Theory states that the reefs begin as bordering reefs or fringing on an island's steep shore. Then, due to the subsidence of the reef flat inside the lagoon, these fringing reefs develop into barrier reefs. The barrier reef eventually extends into atolls with a central lagoon as the island gradually sinks and further disappears.
- The Glacial Control Theory by Daly: The development of ice caps during the last glacial era decreased the ocean's water level to 60-70 meters. Extremely low temperatures were in effect at that time. Subsequently, the ice melted, and the temperatures increased, which is conducive to the growth of reefs. As a result, Atoll and barrier reefs are created.

Coral Reefs in India

Corals can be found in different regions in the oceans around the world, including the Aleutian Islands along the coastline of Alaska and the mild, tropical waters along the Caribbean Sea.

- The clean, shallow waters in the tropical and subtropical regions or where one can find the richest coral reefs.
- The great barrier reef in Australia, the largest of these coral reef systems, stretches for more than 2400 km (1500 miles).

Below mentioned are the places where one can find major Coral Reefs in India.

Lakshadweep Islands

The island has developed the coral reef that encircles the coastline, which is extremely close to the coastline. There are about 78 different species of coral, as well as fishes, crabs, bivalves, brittle stars, sea stars, sea urchins, sea cucumbers, and sea green turtles.

Andaman and Nicobar Islands

One of the world's richest and most magnificent marine creatures calls it home. There are about 560 different coral species in this area. Shells, whales, dugongs, saltwater crocodiles, sea snakes, dolphins, sea turtles, and other marine species can also be

seen here. Additionally, there are soft corals, wire corals, boulder corals, boomerang corals, and red and brown algae. This is also the largest of all the coral reefs in India.

Gulf of Kutch

In the Gulf of Kutch, a marine sanctuary has been established for Pirotan islands and 42 other nearby islands. It is 58 km in width and 170 km broad. The sanctuary covers a total area of 162.89 square kilometers. The coral reefs in Azad, Pirotana, Narara, and Positara are among the best reefs.

Netrani islands in Karnataka

The Netrani Islands are located in the Arabian Sea, 18 kilometers from Murudeshwar. It boasts some of the best diving experiences on the west coast due to the rich corals. It is home to approximately 69 species of corals.

Gulf of Mannar and Palk Bay

On the Southeast coast in the state of Tamil Nadu are present the Gulf of Mannar and Palk Bay. The 140 km long region connecting Rameshwaram and Tuticorin is where the reef deposits in the Gulf of Mannar are located. The varieties of corals found here are of the shore, platform, patch, and fringing types, which includes a total of 117 different types of coral species. Palk Bay, separated from the Gulf of Mannar by the Mandapam Peninsula, is located on India's southeast coast.

Importance of Coral Reefs

Coral reefs are supremely beneficial for our marine ecosystems. Some of its benefits are listed below:

- Reefs are the most diversified and valuable ecosystems on the earth.
- The ecosystem services coral reefs provide include the protection of shorelines, fisheries, and eco-tourism.
- Reefs are crucial for safeguarding the coastline from storm surges and flooding.
- Coral reefs are the building blocks for intricate food webs and our home to a staggering variety of fish.
- This web's foundation comprises a variety of invertebrates, soft corals, sponges, and algae.
- Corals also act as water purifiers. Most corals and sponges are filter feeders, i.e., eat suspended particles in the water.
- Corals contribute to the ocean by catalyzing nutrient cycling, carbon and nitrogen fixation, and various other processes.

Laws for the Protection of Coral Reefs

The marine reserves of India are safeguarded under the coastal regulation zone (CRZ) of 1991. Building hotels or resorts on coral reefs is strictly prohibited under section 7(2)

of the CRZ. In addition, some states forbid coral reef mining, other than the exception of scientific research.

Coral Bleaching

Coral bleaching is a condition when the white calcium carbonate exoskeleton is visible through the transparent tissue. The loss of symbiotic algae called zooxanthellae, which distributes 90% of the nutrients synthesized by it to the coral, is a result of extreme environmental stress. This leads to coral bleaching.

Corals will eject the algae (zooxanthellae) dwelling in their tissues if the water is too warm, turning the coral white.

Factors responsible for Coral Bleaching

1. Global Warming: Rising temperature of oceanic water due to global warming.
2. Ocean Acidification: Adverse changes in pH value of oceanic water due to acid rain and atmospheric absorption of CO₂ by oceans.
3. Marine Pollution: rising marine pollution and oil spills.
4. Use of explosives for the mining.
5. Ozone depletion results in an increase in solar radiation.
6. Algal bloom.
7. Increase in sedimentation in seas and oceans from rivers due to deforestation.
8. Diseases outbreaks in Coral Reefs also affect the chances of their survival.

Threats on Coral Reefs

- Corals cannot generate the calcium carbonate exoskeletons that they need for their protection due to the sea's growing acidity brought upon by the oceans' absorption of massive amounts of carbon dioxide emitted into the atmosphere due to the burning of fossil fuels.
- Coral reefs are also suffering from water contamination. The growth of corals is hampered by agricultural fertilizers and pesticides, petroleum products, sewage effluent, and eroded soil.
- Both on land and in marine ecosystems, invasive alien species pose a threat. Ballast water is one of the primary sources via which invasive alien species are disseminated in aquatic ecosystems.

Brief analysis of Marine pollution

Marine Pollution is dangerous for marine biodiversity which is the real wealth of earth. Some of the causes and their effects are described as follows:

Cause	Effect
Runoff from agriculture, domestic sewage, etc.	Excess supply of nutrients in water bodies causes eutrophication and thus, algal bloom.
Oil Spills	Marine life becomes devoid of sunlight and oxygen causing direct death and destruction.
Dumping of toxic elements from refineries, oil reservoirs, etc.	Toxicity in a marine organism which leads to biomagnification and early death.
Atmospheric inputs of gases like CO ₂	Oceanic acidification
Ballistic Water issue (explained underneath)	It is dangerous for Biodiversity (very likely causes foreign species invasion)

Ballistic Water issue

During the import and export of items from one country to another via ship, some water is carried along with the ship for loading and reloading related activities. This water is known as ballast water. It contains many microscopic organisms and sediments.

Environmental concern: This water is discharged irresponsibly at the destination site which contains organisms that are not native to the place and thereby, causing the introduction of alien invasive species. For example, loading at Bombay port and unloading at New York port would lead to the introduction of Arabian sea water organisms into a new environment of New York waters which may cause serious harm to that ecosystem.