YBN University, Ranchi

Geography

What are Coral Reefs?

Coral polyps are individual corals that are found on the calcium carbonate exoskeletons of their ancestors. Corals can be found in all the oceans but the biggest coral reefs are mostly found in the clear, shallow waters of the tropics and subtropics. The largest of these coral reef systems, The Great Barrier Reef in Australia, the largest coral reef is more than 1,500 miles long.

Factors Affecting Coral Reefs

- **Extreme climate conditions:** High temperature of water leads to the declination of these corals as they cannot survive in high temperature. As estimated by scientists, most of the coral reefs of the world will soon decline with the increasing rates of ocean warming.
- **Overfishing:** It is another major concern as it is leading to an ecological imbalance of the coral reefs.
- **Coastal development:** Development of coastal infrastructure and tourist resorts on or close by these coral reefs causes significant damages.
- **Pollution:** The toxic pollutants which are dumped directly into the ocean can lead to the poisoning of the coral reefs as it increases the nitrogen level of the seawater leading to an overgrowth of algae.
- **Sedimentation:** Construction along the coasts and islands lead to soil erosion increasing the sediments in the river. As a result, it can smother corals by depriving them of the light needed to survive.

Growth Conditions for Coral Reefs

1. The temperature of the water should not be below 20°C. The most favourable temperature for the growth of the coral reefs is between 23°C to 25°C. The temperature should not exceed 35°C.
2. Corals can survive only under saline conditions with an average salinity between 27% to 40%.
3. Coral reefs grow better in shallow water having a depth less than 50 m. The depth of the water should not exceed 200m.

Types of Coral Reefs

Coral Reefs are differentiated into three categories based on their shape, nature and mode of occurrence.

1. **Fringing Reef:** The coral reefs that are found very close to the land and forms a shallow lagoon known as Boat Channel are called Fringing Coral Reefs. The Fringing Reefs develop along the islands and the continental margins. They grow from the deep bottom of the sea and have their seaward side sloping steeply into the deep sea. Fringing Reefs are the most commonly found coral reefs among the three. For example Sakau Island in New Hebrides, South Florida Reef.
2. **Barrier Reef:** Barrier Reefs are considered as the largest, highest and widest reefs among the three coral reefs. They develop off the coast and parallel to the shore as a broken and irregular ring. Being the largest reef among the all, they run for 100kms and is several kilometres wide. One example of Barrier Reef is the Great Barrier Reef of Australia which is 1200 mile long.
3. **Atolls:** An atoll can be defined as a reef that is roughly circular and surrounds a large central lagoon. This lagoon is mostly deep having a depth of 80-150 metres. The atolls are situated away from the deep sea platforms and are found around an island or on a submarine platform in an elliptical form. For example Fiji Atolls, Suvadivo in Maldives and Funafoothis Atoll of Ellice.

Importance of Coral Reefs

Coral Reefs play an important role in the following ways.

- They protect coastlines from the damaging effects of wave action and tropical storms.
- They provide habitats and shelter for many marine organisms.
- They are the source of nitrogen and other essential nutrients for marine food chains.
- They assist in carbon and nitrogen-fixing.
- They help with nutrient recycling.

- The study of coral reefs is essential for scientifically testable records of climatic events over the past million years.
- The fishing industry depends also on coral reefs. Many fish spawn there, and juvenile fish spend time there before making their way to the open sea. The Great Barrier Reef generates more than 1.5 billion dollars annually for the Australian economy from fishing and tourism.
- Coral reefs are also key indicators of global ecosystem health. They serve as an early warning sign of what may happen to other less sensitive systems, such as river deltas if climate change is not urgently addressed.

Coral Reefs in India

India has its coastline extending over 7500 kilometres. It is due to the subtropical climatic conditions, there are a very few coral reefs in India. The major coral reefs in India includes the Palk Bay, the Gulf of Mannar, the Gulf of Kutch, the Andaman and Nicobar Islands and Lakshadweep Islands. Among all these coral reefs, the Lakshadweep reef is an example of atoll while the rest are all fringing reefs.

Palk Bay

Situated in the south-east coast of India, Palk Bay is separated from the Gulf of Mannar by the Mandapam Peninsula and the Rameshwaram Island and is centred on 9 °17’N and 79° 15′. The one fringing reef in the Palk Bay is 25-30km long, and less than 200m wide lies in the east-west direction of the Pamban channel. This reef has a maximum depth of around 3 m.

The Gulf of Mannar

Situated around a chain of 21 islands, the Gulf of Mannar lies between Tuticorin and Rameswaram at a stretch of 140 km. These 21 islands fall between latitude 8°47′ N and 9° 15′ N and longitude 78° 12′ E and 79° 14’E and form a part of the Mannar Barrier Reef which is 140 km long and 25 km wide.

Andaman and Nicobar Islands

The Andaman and Nicobar Islands fall between 6°-14° N lat and 91 °-94° E longitude. They are situated at the south-eastern part of the Bay of Bengal and consist of 350 islands, of which only 38

are inhabited. These islands extend southward from the Irrawaddy Delta of Burma to the Arakan Yoma Range. All the islands of the Andaman and Nicobar groups are almost fringing reefs.

The Gulf of Kutch

The Gulf of Kutch is situated in the northern part of Saurashtra Peninsula and is located between 22°15′-23°40′ N Latitude and 68°20′-70°40′ East Longitude having an area of about 7350 sq km. These reefs are of a fringing type and are about 170 km long and 75 km wide at the mouth which narrows down at a longitude of 72° 20′. Due to the mud deposits on various coral reefs, these coral reefs are in a highly degraded condition.

Lakshadweep Islands

Located between 8°N – 12°3'N latitude and 71 °E- 74°E longitude, the Lakshadweep Islands which lies scattered in the Arabian Sea are situated at about 225 km to 450 km from the Kerala Coast. The islands covering an area of 32 km2 consist of 36 tiny islands, 12 atolls, 3 reefs and 5 submerged banks, with lagoons occupying about 4200 km2.

Due to the warm humid climate of these islands, the temperature of the water varies between 28-31 °C with salinity ranging from 34% – 37%.

The Coral Reefs included in the GS – I section of the UPSC Syllabus is an important topic to be covered. IAS aspirants should also keep a track of the latest current affairs topics to score well in the examination.

What is Coral Bleaching?

The coral and the zooxanthellae share a symbiotic relationship and 90% of the nutrients that are produced by the algae are transferred to the coral hosts. But this relationship gets affected under severe environmental stress which causes the loss of symbiotic algae (zooxanthellae). As a result, the white calcium-carbonate exoskeleton is visible through its transparent tissue leading to a condition known as Coral Bleaching. The corals become vulnerable in the absence of the algae and begin to die if the temperature of the sea remains high for weeks.

Check our article on Coral Bleaching to learn about its causes and global examples.

Threats to Coral Reefs

Despite their immense ecological, economic and aesthetic values, it is estimated that 20% of the world's coral reefs have been destroyed. Another 24% are at high risk of collapse, and yet another 26% at risk from long term collapse as a result of human activities. If the present rate of destruction continues, 70% of the world's coral reefs will be destroyed by the year 2050.

The list of factors causing threat to coral reefs are as follows:

- Overexploitation (Over-fishing) – for food, aquarium trade, trinket trade, medicinal purposes.
- Often accompanying over-fishing are destructive fishing practices – such as purse seining, fine-mesh fishing, 'moxy' nets, cyanide fishing and blast fishing – that result in unsustainable damage. 'Moxy' nets, fine-mesh nets and bottom trawlers all damage coral reefs.
- Marine pollution in the form of oil (that often leaks into the seas), discharge of ballast water, dumping of solid waste from ships is also causing damage to coral reefs in the region.
- Poorly managed tourism has both direct and indirect negative effects on coral reefs. Snorkelling, diving and boating can cause direct physical damage to reefs, while overexploitation of reef species as food, for aquaria and as curios for tourist markets can threaten the survival of species.
- Global warming and resultant climate change is posing an emerging and severe additional threat to already stressed coral reefs.
- The coral reefs are also threatened by the increase in ocean temperatures, coral bleaching, sea level rise, more dissolved carbon dioxide, Ocean acidification.
- Invasive Alien Species are as much of a threat in marine environments as they are on land. One of the main channels of spreading IAS in marine habitats is through ballast water.

Snowflake Coral – A Threat to Biodiversity

Carijoa Riisei also known as snowflake coral is an invasive species discovered recently by the scientists off the coast of Thiruvananthapuram and Kanyakumari. These fast-growing species were

found at a depth of 10m off Kovalam in Thiruvananthapuram and at a depth of 18m off Enayam in Kanyakumari.

The snowflake coral is known to cause a serious threat to the marine ecosystem due to the following reasons:

1. According to a survey conducted on Maui Black Coral Bed in 2001, it was found that the snowflake corals killed 60% of the black coral trees which was found between 80 metres to 150 metres depth.
2. They consume large quantities of the zooplanktons which can have a high ecological impact.
3. They threaten the biodiversity by displacing the native species and by monopolizing food resources.
4. It has the capacity to invade space and as a result, it can crowd out marine species like corals, algae and sponges that play a major role in maintaining the marine biodiversity.

Coral Reefs Conservation Efforts

20% of the world's coral reefs have already been destroyed. Therefore, much has to be done in the future for the conservation of coral reefs.

1. Establishment of marine protected areas
2. Prevention of over-harvesting through legislation
3. Monitoring of coral reefs is essential for the development of effective management strategies
4. Building awareness about coral reefs, their diversity and the services they provide, helps greatly in mitigating the threats to these fragile ecosystems
5. Supporting participation and sustainable livelihoods in reef-dependent communities

Microbial Biodiversity of Coral Reefs

Researchers have discovered that Pacific Ocean coral reefs alone host nearly 3 million varieties of bacteria. The findings suggest that the Earth's microbiome is significantly underestimated, indicating a much higher bacterial diversity than previously thought.

Tara Pacific Expedition and Findings:

- Researchers conducted the Tara Pacific Expedition from 2016 to 2018, visiting 99 coral reefs.
- Samples were collected from plankton, three coral species, and two fish species, resulting in 5,392 samples.
- Genetic analyses were used to categorize the bacterial varieties present in each sample.
- Over 540,000 bacterial varieties were identified across the three types of organisms studied.
- This number alone represents up to 20 per cent of current estimates for all bacteria on Earth (2.72 million to 5.44 million).
- Considering the number of fish and coral species in the western and central Pacific, coral reefs in that region may harbour at least 2.8 million types of bacteria.

Importance of Microbes in Coral Reefs:

- The vast microbial diversity in coral reefs serves as "ecological insurance" for their survival.
- Multiple types of bacteria can fulfil similar functions, such as providing essential nutrients to coral polyps.
- With such diversity, bacteria populations can adapt and replace each other during environmental disturbances, ensuring the reef's resilience.

Limitations and Future Research:

- The estimated microbial diversity in Pacific reefs may still be an underestimate.
- Invisible to the naked eye, microbes are challenging to quantify accurately using current methods.

- Molecular tools used for genetic analysis may exclude unknown organisms, further complicating assessments of microbial diversity.

Conclusion:

- Coral reefs host an immense variety of bacteria, far surpassing previous estimations of microbial diversity.
- This hidden biodiversity plays a crucial role in the health and resilience of coral reef ecosystems.
- Further analysis of the data collected during the Tara Pacific Expedition is expected to provide deeper insights into the functions and interactions of these microbial communities.