



## Corals in Gujarat – A review

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### Abstract

**Background:** The state of Gujarat, in the northwestern region of India has the longest coastline, covering more than 1,600 km and accounts for 22% of total coastline of the country with a diversity of habitats, especially mangroves, salt marshes, coral reefs, wetlands and sea grasses.

**Aim:** To educate and enlighten readers about the flourishing marine life of Gujarat's Coral life.

**Methods:** Based on web search using the following keywords, information was compiled and elicited

**Results:** It is found that many indigenous and non indigenous coral species that have occupied the coastal areas of Gujarat. The Gulf of Kutchh is home to coral reefs and India's first marine national parks.

**Conclusion:** Although the coastal region of Gujarat is rich in Coral biodiversity, there are still many undiscovered regions which need further exploration by marine biologists. Moreover, the government of India can set up museums near these parks to educate the local as well as tourists to enable promotion as well as preservation of marine life.

**Key words:** Coral, coastal, Gujarat, marine sanctuaries

### I. INTRODUCTION

Corals are marine invertebrates in the class Anthozoa of phylum Cnidaria. They typically live in compact colonies of many identical individual polyps. The group includes the important reef builders that inhabit tropical oceans and secrete calcium carbonate to form a hard skeleton. Coral polyps are tiny, soft-bodied organisms related to sea anemones and jellyfish. At their base is a hard, protective limestone skeleton called a calicle, which forms the structure of coral reefs [1, 2].

#### Classification

**Kingdom:** Animalia

**Phylum:** Cnidaria or Coelenterata

**Class:** Anthozoa

**Type:** Invertebrate

**Diet:** Carnivore

**Size:** Polyp, 0.25 to 12 in (0.63 to 30.5 cm)

The average life span of a polyp in the wild is 2 to hundreds of years and that of a colony is 5 years to several centuries. Their protection status is currently "Endangered"

The term coral refers to group of invertebrate animals belonging to Phylum 'Cnidaria or Coelenterata' and Class 'Anthozoa' [3, 4].

However, the class is further divided into two subclasses viz. Zoantharia and Alcyonaria.

The former sub-class possesses coral species that are commonly known as 'Scleractinian' or 'hard corals', while the later sub-class includes 'soft corals'.

The Scleractinian coral species (or hard corals) are further divided into two types [3,4]:

**1. Hermatypic:** They live in colonies and release calcium carbonate to form 'reefs'. Further, these coral species contain millions of tiny algal cells, zooxanthellae, within their tissues.

These algae possess green pigments and through photosynthetic activities provide energy to the coral species. These types of corals are mostly found near the sea surface.

**2. Ahermatypic:** They do not form colonies and thus despite releasing calcium carbonate they do not form 'reefs'. Unlike hermatypic corals, these species are devoid of green pigments and possess red or yellow photosynthetic pigments. Due to this they can establish themselves in the deeper waters.

While the ahermatypic type is widely distributed at all latitudes down to several thousand meters depth, the hermatypic corals are limited to warm saline waters where temperature never falls below 20°C and salinity is not lower than 30 ppt.

The soft corals are different from the hard corals in the sense that instead of forming skeleton of calcium carbonate, they formed spicules of calcium carbonates, which gives a soft feeling in touch, and can be pressed to a certain degree. Like Scleractinian, the soft corals also form colonies but do not contain photo-synthetically active zooxanthellae.

Some species of soft corals are live solitarily, too. Due to its structure, these corals are not contributing in "reef" building[1,2,3,4].

## **II. Anatomy**

While the coral head is the familiar visual form of a single organism, it is actually a group of many individual, yet genetically identical, multicellular organisms known as polyps [5].

Polyps are usually a few millimeters in diameter, and are formed by a layer of outer epithelium and inner jellylike tissue known as the mesoglea. They are radially symmetrical, with tentacles surrounding a central mouth, the only opening to the stomach or coelenteron, through which food is ingested and waste expelled. (fig.1)

### **1. Colonial form**

The polyps interconnect by a complex and well-developed system of gastro vascular canals, allowing significant sharing of nutrients and symbiotes. In soft corals, these range in size from 50–500 micrometers (0.002–0.020 in) in diameter, and allow transport of both metabolites and cellular components [6].

### **2. Exoskeleton**

Formation of the calcareous exoskeleton involves deposition of the mineral aragonite by the polyps from calcium and carbonate ions they acquire from seawater. The rate of deposition, while varying greatly across species and environmental conditions, can reach 10 g/m<sup>2</sup> per day (0.3 ounce/sq yd/day). This is light dependent, with night-time production 90% lower than that during the middle of the day [5,6,7].

### **3. Tentacles**

Nematocysts at the tips of the calices are stinging cells that carry venom which they rapidly release in response to contact with another organism. The tentacles also bear a contractile band of epithelium called the pharynx. Jellyfish and sea anemones also carry nematocysts.

### **4. Nervous system**

Modified epidermal cells -- neurons -- contain long, thin strand-like processes, called neurites, synapsing into each other and creating a basic neural network. Corals and other cnidarians have two separate networks: one fast conducting and one slow conducting. It is believed that corals were one of the first animals to evolve such networks -- sponges have ion channels and inactive DNA for neuron production, but corals realize them fully [5,6,7].

## **III. Feeding**

Although some corals can catch small fish and plankton, using stinging cells on their tentacles, like those in sea anemone and jellyfish, most corals obtain the majority of their energy and nutrients from photosynthetic unicellular algae that live within the coral's tissue called zooxanthella (also known as Symbiodinium). Such corals require sunlight and grow in clear, shallow water, typically at depths shallower than 60 meters (200 ft) [1,3,5,7,8].

The polyp's tentacles immobilize or kill prey using their nematocysts (also known as 'cnidocysts'). The tentacles then contract to bring the prey into the stomach. Once the prey is digested, the stomach reopens, allowing the elimination of waste products and the beginning of the next hunting cycle. They can scavenge drifting organic molecules and dissolved organic molecules [8].

## **IV. Reproduction**

Corals can be both gonochoristic (unisexual) and hermaphroditic, each of which can reproduce sexually and asexually. Reproduction also allows coral to settle in new areas [2,4,6,8, 9, 10].

### **1. sexual**

Corals predominantly reproduce sexually. About 25% of hermatypic corals (stony corals) form single sex (gonochoristic) colonies, while the rest are hermaphroditic.

Synchronous spawning is very typical on the coral reef, and often, even when multiple species are present, all corals spawn on the same night. This synchrony is essential so male and female gametes can meet.

Corals rely on environmental cues, varying from species to species, to determine the proper time to release gametes into the water. The cues involve temperature change, lunar cycle, day length, and possibly chemical signaling. Synchronous spawning may form hybrids and is perhaps involved in coral speciation. The immediate cue is most often sunset, which cues the release. The spawning event can be visually dramatic, clouding the usually clear water with gametes. (fig. 2)

## **2. asexual**

Within a coral head, the genetically identical polyps reproduce asexually, either via gemmation (fig.3) or by longitudinal or transversal division.

**Budding** involves splitting a smaller polyp from an adult. As the new polyp grows, it forms its body parts. The distance between the new and adult polyps grows, and with it, the coenosarc (the common body of the colony; see coral anatomy). Budding can be:

- **Intratentacular**—from its oral discs, producing same-sized polyps within the ring of tentacles
- **Extratentacular**—from its base, producing a smaller polyp

Asexual reproduction has several benefits for these sessile colonial organisms:

- Cloning allows high reproduction rates, supporting rapid habitat exploitation.
- Modular growth allows biomass to increase without a corresponding decrease in surface-to-volume ratio.
- Modular growth delays senescence, by allowing the clone-type to survive the loss of one or more modules.
- New modules can replace dead modules, reducing clone-type mortality and preserving the colony's territory.
- Spreading the clone type to distant locations reduces clone-type mortality from localized threats (Wikipedia.org).

## **Important reefs around the world**

- The Great Barrier Reef—largest, comprising over 2,900 individual reefs and 900 islands stretching for over 2,600 kilometers (1,600 mi) off Queensland, Australia
- The Mesoamerican Barrier Reef System—second largest, stretching 1,000 kilometers (620 mi) from Isla at the tip of the Yucatán Peninsula down to the Bay Islands of Honduras
- The New Caledonia Barrier Reef—second longest double barrier reef, covering 1,500 kilometers (930 mi)
- The Andros, Bahamas Barrier Reef—third largest, following the east coast of Andros Island, Bahamas, between Andros and Nassau
- The Red Sea—includes 6000-year-old fringing reefs located around a 2,000 km (1,240 mi) coastline
- The Florida Reef Tract—largest continental US reef, extends from Soldier Key, located in Biscayne Bay, to the Dry Tortugas in the Gulf of Mexico
- Pulley Ridge—deepest photosynthetic coral reef, Florida
- Numerous reefs scattered over the Maldives
- The Philippines coral reef area, the second largest in Southeast Asia, is estimated at 26,000 square kilometers and holds an extraordinary diversity of species. Scientists have identified 915 reef fish species and more than 400 scleractinian coral species, 12 of which are endemic.
- The Raja Ampat Islands in Indonesia's West Papua province offer the highest known marine diversity [11, 12].

## **Coral reefs in India**

The total coral reef area in India is 5,790 km<sup>2</sup>, distributed between four major regions: the Lakshadweep, Gulf of Mannar, Andaman and Nicobar Islands, and Gulf of Kachchh. Reef structure and species diversity vary considerably between the areas due to differences in the reef extent and geo-environmental conditions. Out of three major reef types, the Indian coastal waters mostly supported fringing types

There are 18 different families of corals reported from the world of which 15 are represented in India (total of 199 hermatypic and ahermatypic coral species, divided among 37 genera) [11,12].

## **Corals in Gujarat**

The coastline of Gujarat has two indentations, the Gulf of Kachchh and Gulf of Cambay covering about 60% of the state coastline [13-19] (Table 1).

The entire Gujarat coast has been broadly divided into five distinct but interconnected regions. These include, (i) Gulf of Kachchh, (ii) Gulf of Cambay, (iii) Saurashtra Coast (iv) South Gujarat Coast and (v) Rann of Kachchh

Gulf of Kachchh (GoK) is very rich in terms of biodiversity values. The GoK support varied habitats including coral reefs, mangroves, creeks, mud flats, islands, rocky shore, sandy shore etc., which in turn provide suitable environment for wide range of flora and fauna [17]

*In 1982, out of total 457.92 km<sup>2</sup> area of the Marine Sanctuary, an area of 162.89 km<sup>2</sup> was notified as Marine National Park (MNP), which happened to be the first Marine National Park of the country (Figure 4)*

**Table 1. Ecologically Important Coastal Areas identified in Gujarat coast.**

Site	Ecological Importance	Geographic Location	Area in km	Coastal Length Km
Gulf Kachchh	Mangrove Coral Reef	20°15' to 23°35' N 60°05' to 70°22' E	1307.8 (Mangrove) 406.5 (Coral)	131.4 Km (Mangrove) 94.91km (Coral Main) 75.4 Km (Coral Island)
Gulf of Khambhat	Estuary	22°15'-22° 30'N 72°15'-72° 30'E	6.4 (Mangrove)	2.63 km (Mangrove)

[13]

Out of total 42 islands in Marine National Parks (MNPS), 20 islands have mangroves and 33 support coral reefs. These reefs are mainly located close to 42 islands situated along the southern tip of the Gulf of Kutch (GoKs). However, compilation from existing literature could confirm a total of 68 coral species from the GoK: 45 hard corals and 23 soft coral species [13-19].

## **Details about India's first Marine National Park**

**Jamnagar has the Country's first Marine National Park, since 1982. One just has to walk in the water, when the tide ebbs, in about 1 to 2 feet of water and watch this fascinating underwater world of corals. This is one of the rare places in the world where one can look at corals without having to dive down into the water.**

Coral reef needs specific geo-physical and chemical requirements for their growth and development. The optimum temperature for the growth of coral reefs is 25-30°C. At temperature below 15°C, the coral growth gets restricted or ceased, while, sea-water temperature above 36°C causes their bleaching.

Because of the above environmental requirements, coral reefs are mostly located in tropical waters. The GoK and Mithapur and Dwarka are the only areas in Gujarat where coral reefs exist.

Based on the existing classifications most of these reefs are grouped into fringing types. However, solitary and soft corals are also reported near Mundra, Mandvi and Kandla in Kachchh and in the Arabian Sea along the Saurashtra coast According to satellite imagery based assessment, coral reefs in GoK occupies an area of about 460 km<sup>2</sup>.

In Gulf of Kutch, 42 islands sit like little gems in the Arabian Sea. Fringed by coral reefs, sandy beaches and mangrove swamps, these islands are a treasure-trove of marine species and a paradise for birdwatchers.

The Marine Sanctuary area has:

- Coral Reefs
- 37 species of Hard & Soft Corals
- 70 species of Sponges
- 27 species of Prawns
- 30 species of Crabs
- 200 species of Mollusks
- Endangered Sea Turtles like the Green Sea, Oliver Riddley & Leather Back.
- 3 Species of Sea Mammals
- 94 species of Water Birds
- 78 species of terrestrial birds and 108 species of brown, green & red Algae [16-18].

### **Protection of corals**

Many governments now prohibit removal of coral from reefs, and Inform coastal residents about reef protection and ecology. While local action such as habitat restoration and herbivore protection can reduce local damage, the longer-term threats of acidification, temperature change and sea-level rise remain a challenge.

To eliminate destruction of corals in their indigenous regions, projects have been started to grow corals in non-tropical countries.

Marine Protected Areas (MPAs) have become increasingly prominent for reef management. MPAs promote responsible fishery management and habitat protection. Much like national parks and wildlife refuges, and to varying degrees, MPAs restrict potentially damaging activities. MPAs encompass both social and biological objectives, including reef restoration, aesthetics, biodiversity, and economic benefits.

But Only 27% of coral reefs are in MPAs. In addition, only 15% of sites were considered effective, with 38% being partially effective and 47% being ineffective. This leaves only 6% of coral reefs in effectively managed MPAs.

The WWF has managed to get a commitment by the six Coral Triangle nations through the Coral Triangle Initiative to protect the marine environment and resources of the region. The Coral Triangle Initiative Leaders' Declaration is the most detailed regional action plan for ocean conservation ever seen.

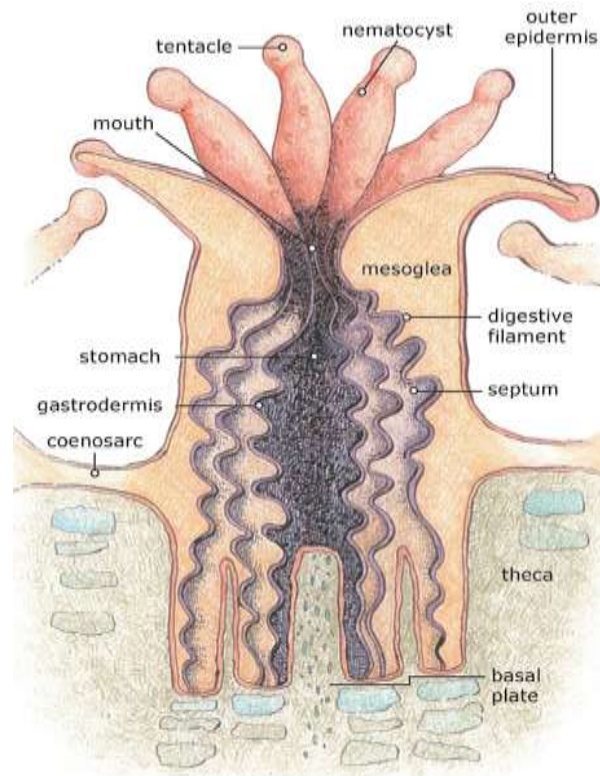
## **Corals and Humans**

Local economies near major coral reefs benefit from an abundance of fish and other marine creatures as a food source. Reefs also provide recreational scuba diving and snorkeling tourism. These activities can damage coral but international projects such as Green Fins that encourage dive and snorkel centers to follow a Code of Conduct has been proven to mitigate these risks.

Live coral is highly sought after for aquaria. Soft corals are easier to maintain in captivity than hard corals

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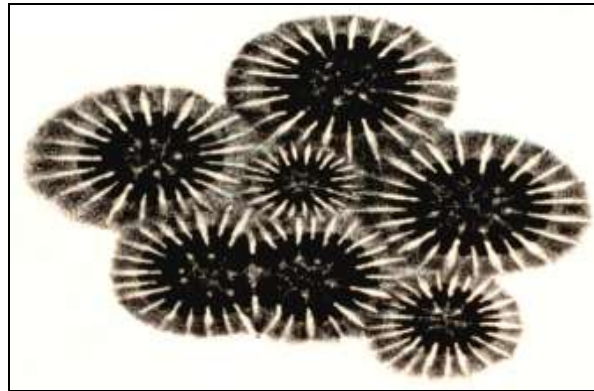


**FIG 1 ANATOMY**

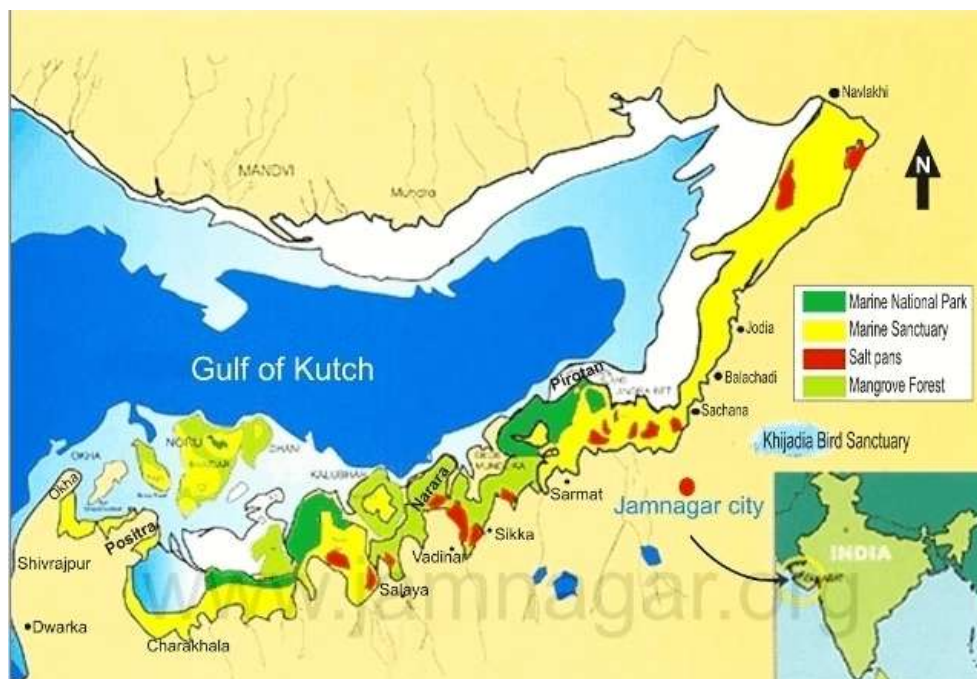


**FIG 2 A MALE STAR CORAL, RELEASES SPERM INTO THE WATER**





**FIG3 CALICES (BASAL PLATES) OF ORBICELLA ANNULARIS SHOWING MULTIPLICATION BY GEMMATION (SMALL CENTRAL CALICE) AND DIVISION - LARGE DOUBLE CALICE**



**FIG 4 MAP SHOWING AREAS OF MARINE NATIONAL PARK AND SANCTUARY IN GULF OF KUTCH, GUJARAT**

