Aravali Foundation for Education

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सत्यमेव जयते

Mangroves for the Future
INVESTING IN COASTAL ECOSYSTEMS

Coral Reefs

Rainforests of the Oceans

Produced by Mangroves for the Future (MFF) India
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भारत सरकार
पर्यावरण एवं वन मंत्रालय
Secretary
Government of India
Ministry of Environment and Forests

FOREWORD

I am pleased that the Mangrove for the Future (MFF) is bringing out this illustrative publication on the Coral Reef ecosystems which are a harbinger of coastal and marine biodiversity. The book is aptly titled as coral reefs are akin to tropical rainforests and they often support even greater biodiversity than tropical rainforests.

India has four major reef ecosystems, including the Gulf of Mannar which is a designated Biosphere reserve under the UNESCO's Man and the Biosphere Programme. The illustrative publication provides useful information aided by high quality photographs on the diversity and splendour of these ecosystems. The book also describes the various threats that they face and the various international and national initiatives in place for addressing the long-term conservation of these ecosystems.

It gives me immense pleasure to present the book during the UN decade on Biodiversity 2011-2020 as well as India's presidency following the hosting of the Eleventh Conference of Partiesto the Convention on Biological Diversity in October 2012 at Hyderabad.

Corals and Coral reefs of our country enjoy legal protection. They are recognized as Schedule-I animals under the ambit of Wildlife Protection Act (1972). There is a Coastal Regulation Zone Notification 2011 which calls for protection of ecologically sensitive areas like coral reefs. Residuary issues not addressed by this notification can be taken care of through subordinate legislation under the Environment Protection Act (1986).

I am sure that this publication will aid in improving the awareness levels among our children and youth on these living monuments. I congratulate all those who were involved in the preparation of the book.

07/9/2013

Dr. V. Rajagopalan

जहाँ है हरियाली।
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Acknowledgements

The marine realm is far larger than the terrestrial realm; the Pacific Ocean alone would be able to accommodate all the continents and have enough space for a second India! Marine and coastal ecosystems, like all ecosystems, are intricate webs of complex interactions among macro and microscopic species of plants, animals and fungi that depend on each other to survive. Over and above being sources of rich biodiversity, these ecosystems provide integral benefits to mankind.

Mangroves for the Future (MFF) India, through this series of publications, intends to pique the curiosity and increase awareness amongst youth on marine and coastal ecosystems and serve as an educational resource material in classrooms in India and around the world.

We would like to thank the Ministry of Environment and Forests, Government of India and the National Coordination Body (NCB) India for their support and guidance.

Thanks to Deepak Apte, Digant Desai and Dhritiman Mukharjee for generously sharing photographs in *gratis*.

We also would like to thank T S Nayar, Kartik Shanker, R Jayabaskaran, K Kathiresan, K Sivakumar, Ramamoorthy, V Vivekandan, Arjan Rajasuriya, D S Jayakodi and Rudolf Hermes for their scientific inputs.

Contents

Magnificent Coral Reefs

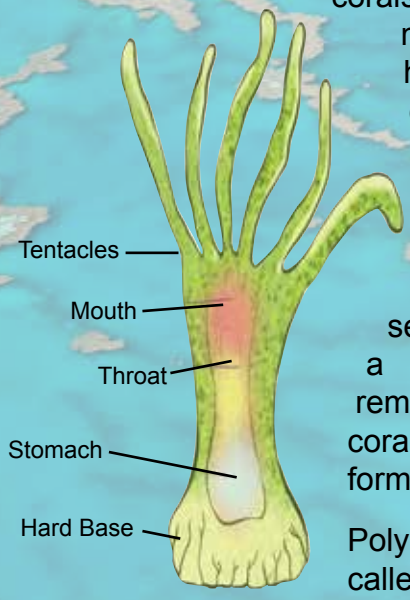
Living monuments

Coral reefs are one of the largest and most diverse ecosystems on earth. A coral reef may look like a collection of rocks and boulders but in reality it is a colony of tiny invertebrates called coral polyps.

Corals are extremely ancient animals that evolved into their modern reef building forms over millions of years.

Coral Polyps
Small **Size,** Huge **Task**

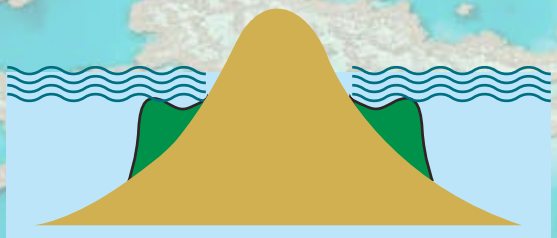
There are hard (stony) corals and there are soft corals. But it is the hard corals that make a coral reef. Hard corals have skeletons made of calcium carbonate (limestone) secreted by the polyp.



Hard Coral Polyp
Cross-section

Each polyp is an individual organism that begins life as a tiny free swimming larva but ultimately settles, never to move again, on a hard surface (normally skeletal remains of dead corals), and form a coral colony. These colonies together form a coral reef.

Polyps have a ring of stinging cells called nematocysts to help them hunt small prey.



Fringing Reef

Fringing Reefs grow close to the shoreline of volcanic islands and extend towards the sea as a platform. Fringing reefs are the most common reef type and can take 100,000 years to form.

Useful Weblinks
animals.nationalgeographic.co.in
coral-reef-info.com

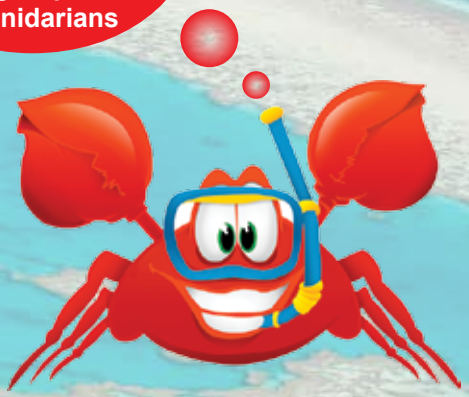
Clark's Anemone Fish
Amphiprion clarkii

Like all things grand and magnificent, coral reefs also took a long time, a very long time, to be what they are today in terms of their grandeur as well as beauty. Primitive ancestors of coral reefs formed in the seas about 400-500 million years ago, much before life emerged on land. And they have not stopped building since then.

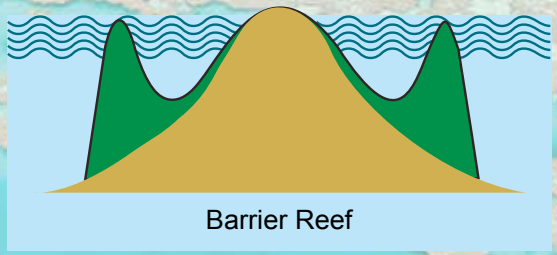
Aerial view of Great Barrier Reef, Queensland, Australia

Photo : Peter Adams/gettyimages

Coral polyps are related to jellyfish and anemones. They all belong to the animal group known as Cnidarians

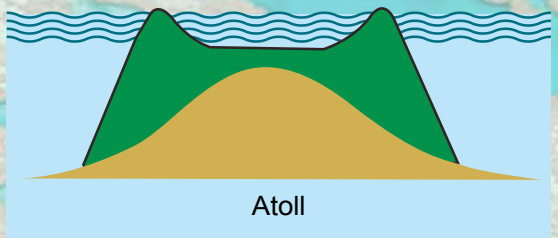


It was none other than **Charles Darwin**, who also gave us the theory "survival of the fittest", who first classified coral reef formations based on observations during his voyages. His classification, according to the shape and size of coral reefs, still holds good.



Barrier Reef

Barrier Reefs grow parallel to the shoreline and develop due to the subsiding of islands around which fringing reefs grow. They are separated from the mainland by a deep lagoon.



Atoll

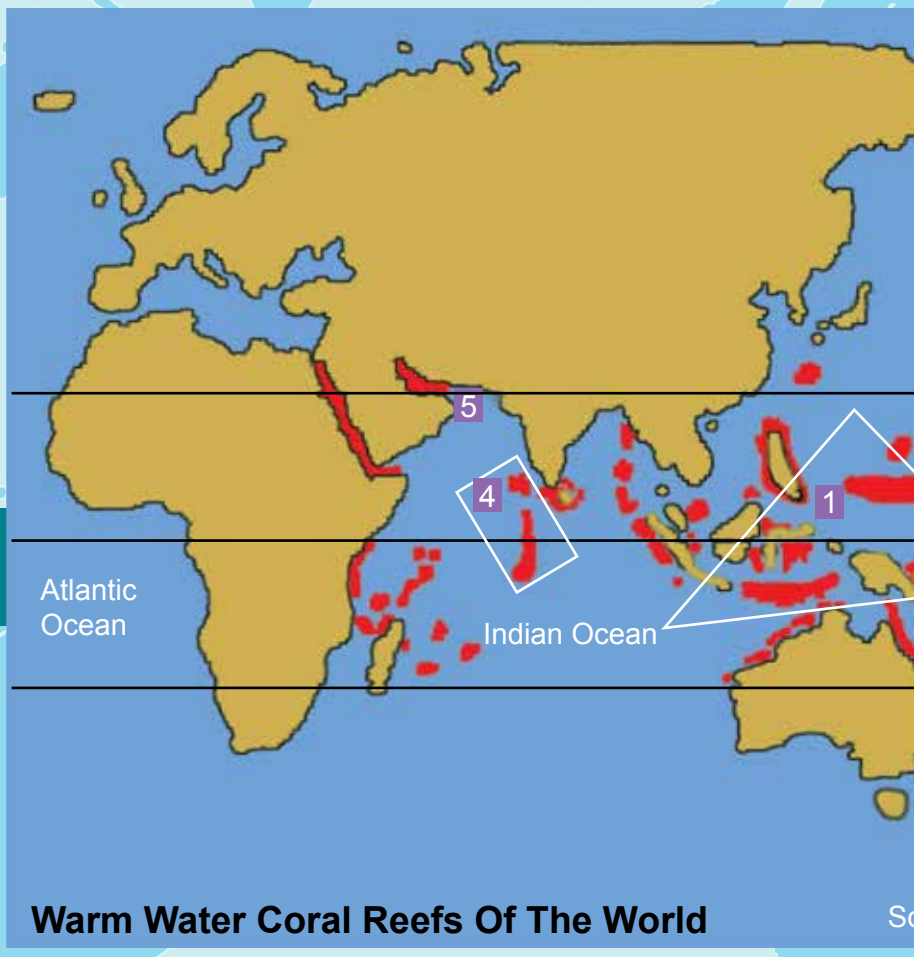
Atolls are reefs that grow around islands, which gradually sink into the sea over centuries due to volcanic activity leaving the reef behind. Atolls can take up to 30 million years to form.

Land
Reef

Redfin Butterfly Fish
Chaetodon trifasciatus

Expansive Coral Reefs
Splendid spread

Although distributed across 100 countries worldwide and vital for coastal protection, tourism and marinelife, including fisheries, coral reefs occupy an area of about 284,300 km^2. This is less than 0.2% of the total area under oceans. Yet coral reefs support about 25% of all marine species.



Warm Water Coral Reefs Of The World

CORALS **FUSSY** ABOUT **HABITAT**

Very sensitive to temperature, reef forming corals thrive best in ocean waters that average around 27-28°C. No wonder, most of the world's large coral reef formations are found in the warm oceans of the tropical belt. Apart from a stable seawater salinity (34-36 psu), corals also need abundant sunlight and prefer clear and shallow waters, narmally upto 50 m depth.

Coelacanths Photo : Peter Scoone/gettyimages

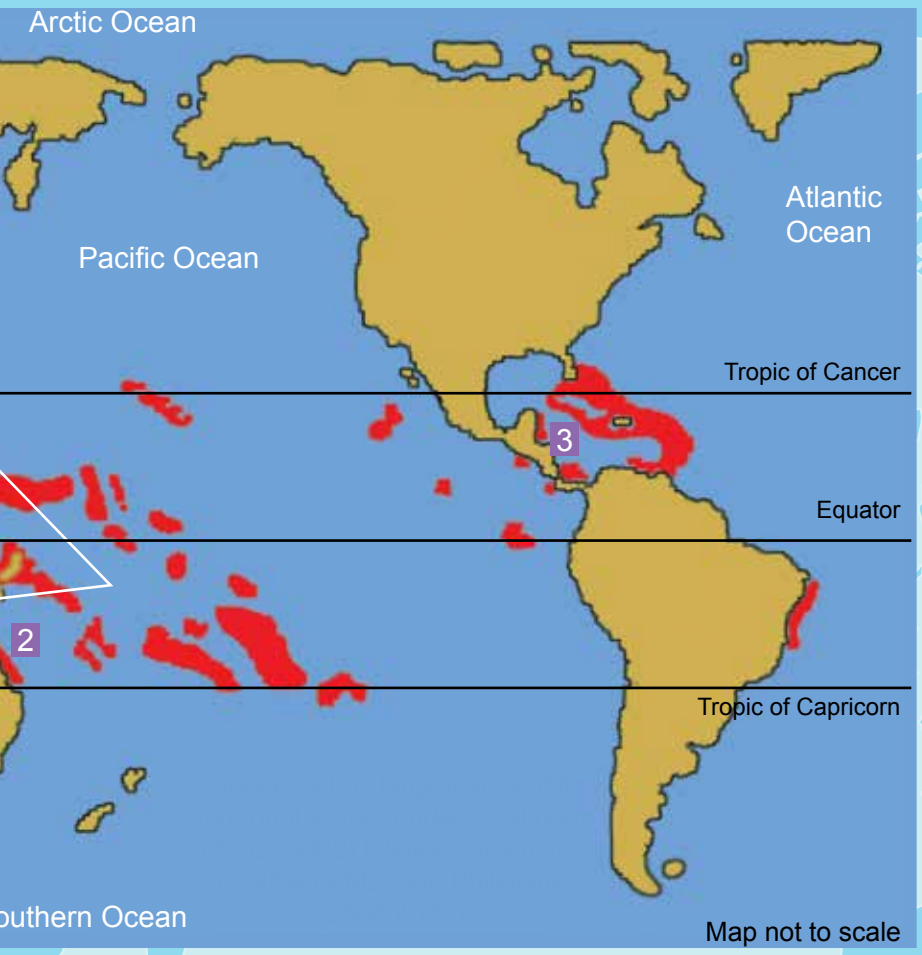
were thought to have gone extinct with the dinosaurs. Rediscovered in 1938, these "living fossils" have only two known species. One of them, ***Latimeria menadoensis*** *is found only in the Coral Triangle.*

Useful Weblinks
geography.about.com | iucn.org

Long-jawed Squirrel Fish
Sargocentron spiniferum

France, though located much outside the tropical belt, comes in fourth (after Indonesia, Australia and Philippines) with 14,280 km² of reefs located in its tropical overseas territories.

Cold water corals have been found in temperate oceans at depths upto 1,000 m, in temperatures as low as 4°C! Over 4,200 species of cold water corals have been recorded.



PROMINENT **REEF FORMATIONS** OF THE WORLD

1. Coral Triangle

Spread across several countries in the Asia Pacific region, the Coral Triangle is home to more species than any other marine area in the world and is called the underwater equivalent of rainforests of the Amazon.

2. Great Barrier Reef

1900 individual reefs stretching across 2300 km make it the world's largest coral reef ecosystem. Even visible from space, it is world's largest structure made by living organisms.

3. Belize Barrier Reef

The largest barrier reef in the northern hemisphere and habitat for threatened species that include marine turtles, manatees and the American marine crocodile.

Red Sea Picasso Trigger Fish
is found only in the coral reefs of the Red Sea. They are so called as they can use the first spine of their dorsal fin as a trigger in defence.

4. Maldives-Chagos-Lakshadweep Atolls

is the largest atoll system in the world and the most extensive coral reef system in the Indian Ocean. The islands that make up the atoll were formed by volcanic eruptions and consist of 1,300 coral islands.

5. Red Sea Coral Reef

Stretches 1,900 km along the Red Sea coastline featuring extensive shallow shelves. The fact that 10% of its 1,200 species of fish are endemic makes it unique.

Christmas Tree Worm
Spirobranchus giganteus

India's Coral Reefs
Necklace of diversity

With just 1% of world's coral reef area in its territory, all major reef types can be found in Indian waters. India has 5790 km^2 of coral reefs. About 25% of all reef forming shallow water corals are found here.

Coral Reefs in India
Geographical Distribution

Along the mainland coast of India, coral reefs are primarily found in the Gulf of Kachchh in the North-West and the Gulf of Mannar in the South-East. Patches of reefs are also found off the Malvan Coast (Maharashtra), Netrani Island and Gaveshani Bank, off the Mangalore Coast (Karnataka).


Photo : Deepak Apte

A vivid view of Coral Reefs in Andaman & Nicobar Islands

Andaman & Nicobar Islands and Lakshadweep archipelago have extensive reefs that are relatively untouched and pristine.

Useful Weblinks
envfor.nic.in | drs.nio.org

Lined Surgeon Fish
Acanthurus lineatus

60-85% of the Indian Coral Reefs reported damages due to episodes of bleaching since 1998. Some of them have shown signs of recovery.

As in other parts of the world, coral reefs in India also contribute significantly to the livelihoods of coastal communities. In the Gulf of Kachchh alone the net annual benefit of coral reef ecosystems has been estimated at USD 47 million.

Near shore turbidity and freshwater runoffs from the numerous rivers dissecting the coastline limit reef development along India's coasts. Coral diseases (often due to polluted marine environment) and onslaught of invasive species are also important factors. The tsunami that struck parts of India in 2004 caused with widespread damage of coral reefs in Andaman & Nicobar Islands.

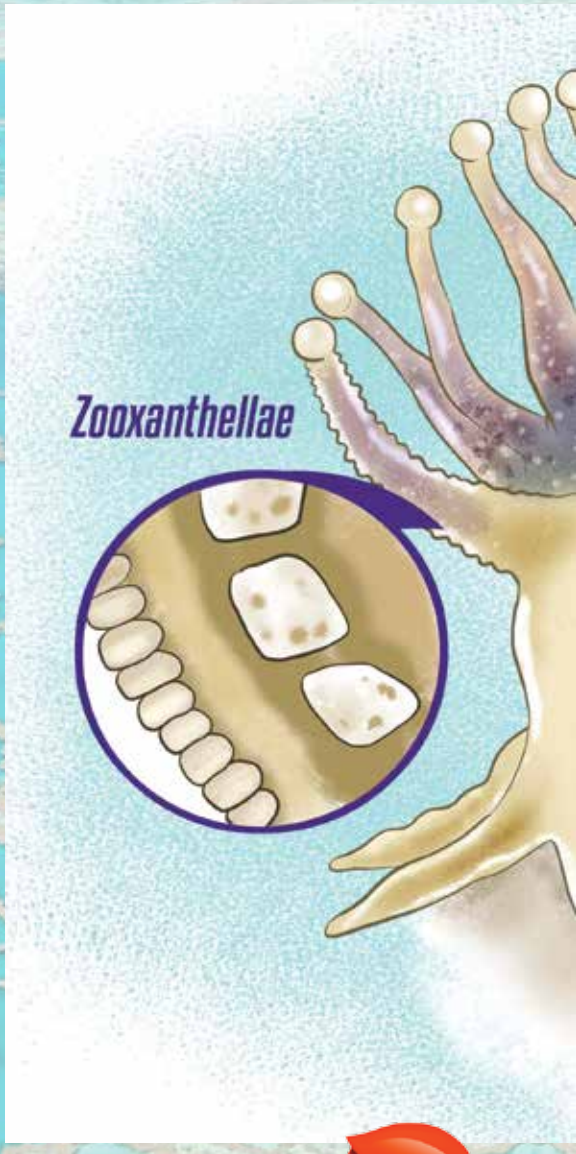
Crown of Thorns
an invasive species in Indian waters that preys on corals.

Blue Sea Star
Linckia laevigata

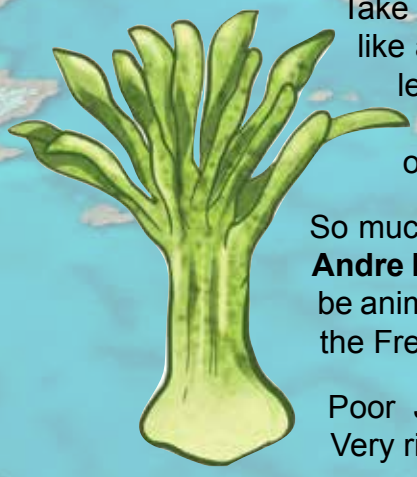
Coral Reef Plants
Small yet significant

For all the diversity of life that they host, the existence of coral reefs rests on coming together of one animal type, the coral polyp (or coral) and one plant type, zooxanthellae (a photosynthetic alga).

These two tiny living beings create a powerful collaboration and form the basis of the coral reef ecosystem that is home to a vast variety of other forms of life that can be millions of times larger than the humble polyp, or the algae that rides on it.



Coral - A **plant** that **never** was!!



Take a close look at a coral and it will look like a flower, not like an animal. No hands, legs, tails, ears or eyes!! No wonder that for centuries humans seriously thought of corals as plants.

So much so that when French naturalist **Jean Andre Peyssonel** suggested that corals might be animals, he was immediately expelled from the French Academy of Sciences!

Poor Jean, as we know today, was right. Very right!.

As much as 90% of the organic material photosynthetically produced by the zooxanthellae is transferred to the host coral tissue.

Useful Weblinks
marinebio.net
reef.crc.org.au

Spotted Eagle Ray
Aetobatus narinari

Coral Reef Plants : Small **but** Beautiful

On healthy coral reefs plants are rather inconspicuous, and appear heavily outnumbered by the sheer abundance of animal life. Algae, seagrass meadows and mangroves are often found on or associated with coral reefs.

Source :
Smithsonian Institution

Algae Abundant in coral reefs, they are the largest and most diverse group of photosynthetic organisms. They vary in size from the microscopic zooxanthallae to the seaweeds, the largest marine forms of primary producers.

Seagrasses Seagrass meadows provide extensive critical nursery grounds for many types of reef fishes, along with conch, spiny lobster and several other commercially valuable species.

Mangroves Located quite a distance from the main reef formations, mangroves nonetheless considerably enhance the abundance and diversity of reef fishes. Seagrass meadows and mangroves both increase the productivity in coral reef ecosystems.

ZOOXANTHELLAE - Powering the Coral **Splendor**

The driving force behind growth and productivity of coral reef, the zooxanthellae, is a photosynthetic alga that lives in the tissues of corals. While the corals provide the alga with a protected environment and compounds needed for photosynthesis, the alga produces oxygen and helps corals to remove wastes and provides them with elements they need to make proteins, fats, carbohydrates and calcium carbonate.

There are upto 2 million single celled algae (each smaller than 0.0004 inches) in one cm² of coral tissue.

Black-tip Grouper
Epinephelus fasciatus

Coral Reef Animals

Awesome diversity

During his voyages on the famous ship 'Beagle', Charles Darwin described tropical coral reefs as "***oasis in the desert of the ocean"***.

In addition to the wide colorful variety of corals, a vast and splendid diversity of other animals find food and shelter in coral reefs. All these species depend on each other through a complex set of relationships for their survival.

Photo : Mathieu Meur/gettyimages

Shrimp and crabs often live on the surface of corals and fish and act as "cleaner stations". They eat mucus, dead skin, parasites or any organic particles that are stuck to their hosts. In return they benefit from the protection provided by the host.

Photo : Deepak Apte

Clown fish lives among the stinging tentacles of sea anemones. They benefit from the protection provided by anemone tentacles and also eat leftovers of anemones meals. In return they clean the anemone and protect it from large fishes. The relationship is called **mutualism.**

When one animal uses another for transportation, the relationship is called **phoresis** (or a hitchhiker relationship). Barnacles or algae, for example, may settle on a crab or turtle carapace.

Photo : Digant Desai

Useful Weblinks
reefrelief.org
marinebiology.org

Mandarinfish
Synchiropus splendidus

There are as much as 850 types of stony (or hard) corals which form the world's coral reefs. Their colorful resplendence is only matched by their variety of shape and size.

Photo : Mark Webster/gettyimages

Staghorn coral

Occurs upto 100 ft. depth. The upper limit is defined by wave forces, and the lower limit by light availability.

Brain coral

Found in shallow and warm water coral reefs. Life span of the largest of brain corals is about 900 years. Colonies can grow as high as 6 ft., or even more.

Photo : Deepak Apte

Photo : Mark Conlin/gettyimages

Soft coral

Unlike stony corals, most soft corals thrive in nutrient rich waters where light intensity is moderate.

Fleshy Sea Pens

A type of soft coral and hence lacking the stony exoskeleton. They can rapidly burrow into the sea floor when faced with a predator.

Photo : Eco/UIG/gettyimages

Pillar coral

Resembles fingers growing up from the sea floor. Can grow upto a depth of 65 ft.

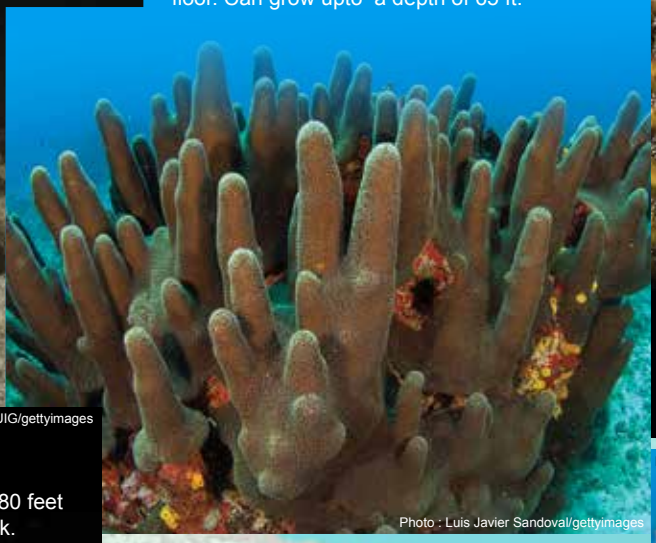


Photo : Luis Javier Sandoval/gettyimages

Photo : Secret Sea Visions/gettyimages

Lamarck's Sheet coral

Polyps of some sheet corals have a ring of stinging tentacles that are capable of catching zooplankton.

Photo : Eco/UIG/gettyimages

Mountainous star coral

Grow together like a chain of mountains upto 80 feet depth. Each colony has a sharply pointed peak.

Octopus atop a mountainous star coral

Photo : Deepak Apte

Pagoda Coral

Colonies are formed by overlapping plates, which vary in shape depending on water depth and light availability.

Photo : Lea Lee/gettyimages

Gorgonia (Soft coral)

Orients its eight tentacles across the prevailing current to maximise water flow towards itself to catch plankton and particulate matter that it consumes.

Caribbean Reef Octopus
Octopus briareus

Buzzing with activity coral reefs provide complex and varied marine habitats that support a wide range of marine fauna.

Fishes

With their dazzling, at times bizarre, colors and patterns, fishes stand out amongst all other marine fauna living on the coral reefs. As many as 8000 species of fish are estimated to inhabit coral reefs.

Parrot Fish
Most abundant fish species on coral reefs.
Feeds on coral polyps.

Photo : Dhritiman Mukharjee

Photo : Dickson Images/gettyimages

Porcupine Fish
Able to puff up their body like a balloon when threatened, they resemble procupines due to the spines they have all over their body.

Photo : Jason Isley - Scubazoo/gettyimages

Trumpet Fish
They often swim vertically to blend in with vertical corals like sea pens.

White Tip Reef Shark
Sharks are the top most predators on the reef.

Photo : David Fleetham/gettyimages

Photo : Georgette Douwma/gettyimages

Sea Horse
Belong to the genus hippocampus, which comes from Greek ***hippos*** *(horse) and* ***kampos*** *(sea monster).*

Box Jellyfish
Chironex fleckeri

Mollusks

Mollusk means "soft", as mollusks do not have a skeleton. Majority of mollusks are benthic, though there are a few open water swimmers as well.

Photo : Deepak Apte

Nudibranch
They have a set of reproductive organs for both sexes, but they cannot fertilize themselves.

Giant Clam
Photo : Deepak Apte
They are the largest bivalves on Earth and no two clams have the same colouration.

Photo : Deepak Apte

Common Reef Squid
They communicate by changing the colour of their skin and can eject black ink to confuse their predators.

Echinoderms

From the Greek words *echínos* (prickly) and *dérma* (skin), they are radially symmetrical animals when adults.

Photo : Deepak Apte

Sea Urchin
Recent research has shown that the sea urchin's teeth are self-sharpening; it can chew through stone.

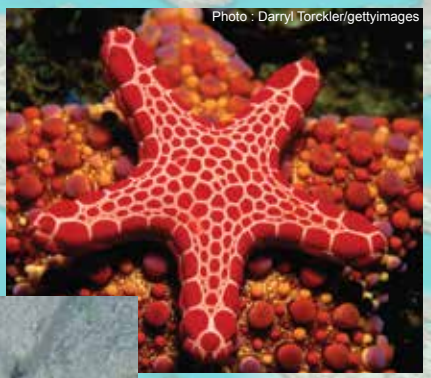


Photo : Darryl Torckler/gettyimages

Star Fish
It can regenerate their arms should they loose one to a predator.

Sea Cucumber
They help recycle nutrients, breaking down detritus and other organic matter after which bacteria can continue the degradation process.

Photo : Karen Gowlett-Holmes/gettyimages

Fire Dartfish
Nemateleotris magnifica

Marine Mammals

Excessive hunting, habitat loss and coastal pollution have contributed to their rapid decimation.

Photo : David Fleetham/gettyimages

Dugong
Related to elephants, they are occasionally sighted in coral reefs as they feed on adjacent seagrass meadows.

Photo : Paul Souders/gettyimages

Humpback Whale
They sing to communicate with each other and to attract potential mates.

Photo : Steve Clancy Photography/gettyimages

Bottlenose Dolphin
They travel in social groups and communicate with each other by a complex system of squeaks and whistles.

Polychaetes

Polychaetes or bristle worms are a diverse class of worms with more than 10,000 species described so far.

Photo : Deepak Apte

Magnificent Tube Worm
They have specialised filtering mechanisms to catch prey.

Photo : Deepak Apte

Christmas Tree Worm
They are commonly found embedded in the head of massive corals

Banggai Cardinalfish
Pterapogon kauderni

Reptiles

Not the most common residents of coral reefs, but definitely among the most beautiful.

Photo : Tobias Bernhard/gettyimages

Black Banded Sea Krait

One of the most venomous snakes on earth. Since they are slow swimmers they survive by ambushing their prey rather than actively chasing them.

Photo : Deepak Apte

Hawksbill Turtle

Marine turtles, unlike their terrestrial siblings, cannot withdraw their head into their shells.

Crustaceans

These are some of the most familiar and commercially valuable species in coral reefs, and include shrimps, lobsters and crabs.

Photo : Copyright Michael Gerber/gettyimages

Mantis Shrimp

Their limbs move so quickly that water around them boils in a process knows as supercavitation. This produces an under sea shockwave that kills their prey.

Photo : Jeff Rotman/gettyimages

Hermit Crab

They often compete with each other for shells which they shed when they become too large.

Photo : Gerard Soury/gettyimages

Spiny Lobster

Also known as rock lobsters, they produce resping sounds with their antennae to repel predators.

Giant Clam
Tridacna gigas

Bountiful Coral Reefs

How they serve

The total net benefit from world's coral reefs has been estimated to be 29.8 billion USD per year. These benefits can be categorized under four main categories namely tourism, coastal protection, fisheries and biodiversity.

The potential value of coral reef fisheries in the Asian region is 38.5% of the global total of 5.7 billion USD. Global coral tourism is worth 9.6 billion USD per year of which Asia accounts for about 50%.

Photo : uw-pix.com/gettyimages

Coral Tourism

Photo : Raul Touzon/gettyimages

Corals in Aquariums

Provisioning Services

Fisheries : As productive as tropical rainforests, a km^2 of a healthy coral reef can yield an average of 15 tonnes of fish and other seafood per year.

Ornamental & Aquarium Fish : Harvesting of corals, fishes and other species for the aquarium is a major form of trade. Mollusks, marine turtles, sea horses, starfish and sea urchins are collected for making curios and souvenirs in coastal areas.

Preventing Coastal Erosion : Coral reefs soften the impact of strong waves and currents on the coastline thereby protecting it from erosion.

Medicines and Medical Research: Many coral reef species have been traditionally employee for medicinal use. Chemicals found in coral reef species are the basis of many modern drugs.

Useful Weblinks
coralreef.noaa.gov | iucn.org

Spotfin Lionfish
Pterois antennata

Only 10% of energy is transferred from one to the next higher level of food chain. No wonder large predators at the end of the food chain are much less numerous than the herbivores at its beginning.

Photo : http://commons.wikimedia.org/wiki

Coastal Erosion

Photo : Juan Silva/gettyimages

Coral Jewellery

Cone Snail

Photo : Deepak Apte

Cultural Services - Recreation & Tourism

Because of their stunning beauty and the vibrant diversity of life forms they host, coral reefs are frequently visited by snorkeling enthusiasts, scuba divers, recreational fishermen and tourists.

Regulating Services
Protection from storms & tidal surges

Coral reefs provide a physical barrier against extreme weather events like storms, tidal surges, strong ocean currents and winds, thus protecting human lives and livelihoods.

Oceans absorb 525 billion tons of carbon dioxide some of which corals use to produce calcium carbonate.

THE CORAL FOOD CHAIN

PHYTOPLANKTON
The basic element responsible for 80% of oxygen production on earth

ZOOPLANKTON
Most abundant animals on earth, feed on phytoplankton

FISH
Feed on Coral Polyps

CORALS
Stinging filaments help in capturing zooplanktons for food

LARGE PREDATORS
Feed on fishes

Each of the 500 odd cone snail species found on or near coral reefs produce as many as 200 toxic compounds which have led to development of painkilling drugs estimated to be 1000 times more powerful than morphine!

Starry Mouthed Nudibranch
Bornella stellifer

Dying Coral Reefs
What's killing them

Coral reefs are dying like never before. It took coral reefs more than millions of years to become what we see them as today. However, world has already lost about 20% of its coral reefs during the last few decades or so due to human activities and their consequences.

This is bad news, very bad news, for more than 2 million marine species that find a home for themselves in these magnificent structures.

Photo : Frans Lemmens/gettyimages

Industrial Pollution

Algal Growth on Corals

Photo : SDMRI

It's getting darker

Like us, corals too need sunlight to survive. However, excessive growth of algae (due to pollution driven increase in Nitrogen levels in water around coral reefs) stops sunlight to reach the corals.

Sediments from construction, mining, agricultural activities in the coastal zones and poorly planned coastal development and unregulated tourist influx make sea water turbid and polluted. This also cuts off sunlight to coral reefs.

53% of Indonesia's coral reefs are threatened by destructive fishing practices.

Useful Weblinks
coral.org | reefresilience.org

Nudibranch
Phyllidia varicosa

Photo : Secret Sea Visions/gettyimages

Coral Bleaching

Its getting warmer

Warming of ocean waters (as a consequence of global warming) often leads to the death of the algae that live in them. Once the algae are gone corals appear white (as if bleached). Climate change is projected to lead to sea level rise, many coral reefs may 'drown' due to the lack of light because of the increased volume of water.

Increase in CO_2 dissolved in the ocean makes the waters more acidic. Reacting with coral skeletons the acidic water renders them renders them weaker and slows down their growth rates. Similarly, rising frequency and intensity of storms and wave surges can break coral colonies.

Photo : Borut Furlan/gettyimages

Destructive Fishing Practice

Unsustainable **Fishing Practices**

Fishermen often catch a much larger variety of fishes than what is actually required. Often accompanying over-fishing are destructive fishing practices - such as purse seining, fine-mesh fishing, cyanide fishing and blast fishing - that result in unsustainable damage

Lion Fish - An Invasive Species in the Atlantic Oceans

Photo : Deepak Apte

Invasive **Species**

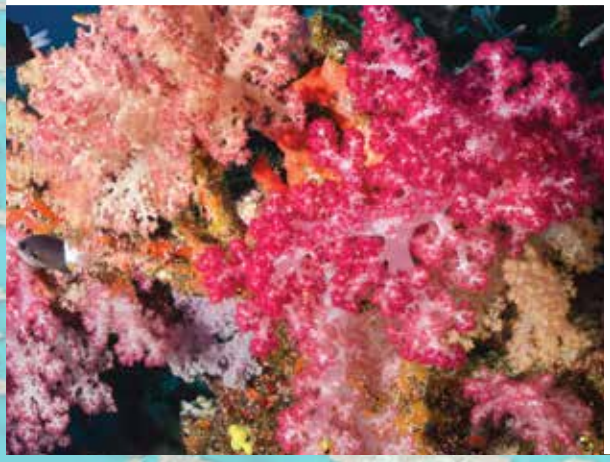
When species alien to coral reefs enter into coral ecosystems, they disrupt the balance of complex relationships that hold a coral reef ecosystem together. Invasive Species are a cause of major decline in health of coral reef ecosystems across the world.

Black-Blotched Moray Eel
Gymnothorax moringa

Conserving Coral Reefs
International efforts

The impressive social, economic, cultural and medicinal values and benefits of coral reefs make for strong arguments for conserving these threatened ecosystems.

Some threats to coral reefs, including sedimentation and destructive fishing practices, are localized within particular nations. Yet other coral reef challenges such as climate change, rise in sea levels, ocean acidification, and inter-national trade in coral products are global in nature.



At present 2.3 % (8.3 million km²) of global ocean area is classified under Marine Protected Areas (MPA). Countries have committed to protect 10% of the ocean by 2020.

Useful Weblinks
whc.unesco.org | cbd.int
cites.org | ramsar.org

Scalloped Hammerhead Shark
Sphyrna lewini

World Heritage Convention (WHC)

Over 878 cultural and natural sites are now on the World Heritage List like the Great Barrier Reef, Belize's Barrier Reef and Tubbataha Reef Marine Park in the Philippines. WHC requires member states to protect and conserve listed sites for future generations.

Convention on Biological Diversity (CBD)

Focusing on "conservation of biological diversity, sustainable use of its components and a fair and equitable sharing of the benefits of genetic resources", CBD directs member states to implement strategies and create protected areas to conserve biodiversity.

Convention on Biological Diversity

Convention on International Trade in Endangered Species (CITES)

CITES provides trade protection for the species listed under various levels of threat. It forbids trade of endangered species except in extraordinary circumstances. Over 2000 coral reef associated species are listed under CITES.

Photo : Pete Atkinson/gettyimages

The Ramsar Convention

Ramsar Convention has been the principal instrument for international cooperation for conservation and wise use of wetlands. A large number of coral sites across the world are yet to be covered by the Ramsar Convention.

Regional Initiatives

Regional reef protection agreements and coordination mechanisms have evolved to seek solutions to particular threats that coral reefs face. Exciting initiatives include; the Coral Triangle Initiative (CTI), The South Asia Cooperative Environment programme (SACEP), Coastal Oceans Research and Development in the Indian Ocean (CORDIO), BoBLME (Bay of Bengal Large Marine Ecosystem) and the Mangroves for the Future (MFF).

150 member countries of the Convention on Biological Diversity have committed to minimise the anthropogenic pressures on coral reefs by 2015 so as to maintain their integrity and functioning (Aichi Target 10)

Redfin Butterflyfish
Chaetodon trifasciatus

Rooting for Coral Reefs

No time to lose

The battle for conservation of coral reefs will not be won in treaties and laboratories, it will be won or lost in the hearts and minds of people. The first step in conservation of these ecosystems is to make the society aware of the complexity of issues and gravity of challenges.

Efforts of the Government of India

Government of India has been pro-active in supporting initiatives that conserve coral reefs.

Environment (Protection) Act, 1986 prohibits the use of corals and sands from the beaches and coastal water for construction and other purposes. Collection and destruction of corals are now banned along with dredging and underwater blasting in and around coral formations (CRZ Notification, 2011).

Under the Marine Protected Area Network, the Gulf of Mannar and Great Nicobar have been declared as Biosphere Reserves while the Gulf of Kachchh (Gujarat), Mahatma Gandhi Marine National Park (Andamans) and Rani Jhansi Marine National Park (Andamans) have been declared as Marine National Parks to provide protection for coral reefs.

33% of reef building corals are classified as threatened by IUCN Red List of Threatened Species (2012).

Useful Weblinks
seaworld.org | iucn.org

Cup Coral
Turbinaria mesenterina

What can we all do as individuals?

Coral reefs are out there in the sea and it is not necessary we all may come in frequent physical contact with them. However, our day to day actions do impact the extent and health of coral reefs in big way. Small steps taken by us can not only make things better for coral reefs but also help us secure our own long-term welfare.

Photo : Pete Atkinson/gettyimages

What to do?

- **Talk about coral reefs**: read more about them and tell your friends and relatives of what you know and understand.
- **Setting an example:** engage in responsible behaviour while having fun on the beaches or inside the sea.
- **Help curb pollution:** Walk, use bicycles or take a bus. Emissions lead to ocean warming, triggering mass-bleaching of corals and often widespread destruction of reefs.
- **Adopt ecological or organic fertilizers**: Water runoff that ends up in the water system, pollutes the ocean and can harm coral reefs and marine life.
- **Watch your trash:** Litter pollutes water and harms reefs and fish that live off them.
- **Raise your voice :** Destructive fishing measures are reducing fish populations. Ask for a labeling regime that helps identify sea food from sustainable sources.
- **Consume sustainable seafood:** Opt for consuming farmed seafood wherever it is possible.

IUCN chairs the Global Coral Reef Monitoring Network which works to strengthen our scientific understanding of these ecosystems

Coral Wizard

Test your instincts. Find as many terms as you can related to coral reefs in the grid below. After you are done see page 28 for full list of such terms.

E	L	A	F	H	O	R	R	A	L	G	A	E
S	L	H	E	N	E	D	A	A	P	S	A	E
C	L	A	E	I	F	S	C	U	E	L	T	I
I	O	S	R	E	Y	I	E	T	L	U	O	S
M	N	R	E	G	P	S	S	E	A	G	L	P
V	A	R	A	O	L	O	H	H	E	N	L	O
B	A	E	R	L	A	T	L	A	G	O	O	N
L	N	E	O	B	N	D	N	Y	K	A	R	G
A	A	F	P	A	K	A	G	A	P	T	S	E
S	E	Y	X	Y	T	C	A	L	I	C	L	E
E	C	O	H	M	O	L	L	U	S	C	U	H
E	O	S	I	I	N	D	I	A	A	I	G	A
Z	H	B	R	J	E	L	L	Y	F	I	S	H

THE CORAL QUIZ

1. **Which of the following species is most commonly found in coral reef habitat?**
   a) Crocodiles
   b) Seal
   c) Oak tree
   d) Sea cucumber

2. **How are coral reefs important for the environment?**
   a) They buffet the coastal areas from storms and strong waves
   b) Algae in coral reefs help remove large amount of CO_2 from water
   c) Provide a habitable ecosystem inside water for marine life
   d) All of the above

3. **What does Algae gain from corals?**
   a) Food in form of undigested remnants of a coral's diet.
   b) A protected environment and compounds needed for photosynthesis
   c) Access to surrounding plants for food.
   d) Supply of fresh water

4. **How do corals benefit from Algae?**
   a) Protection from predators
   b) Oxygen and elements needed to make carbohydrates
   c) Ability to float on sea surface
   d) Layer of Algae on a coral protects it from excessive exposure to sun.

5. **Corals/ Polyps can reproduce by**
   a) Asexual reproduction (producing identical clones)
   b) Sexually (by sending eggs or sperms)
   c) Both asexually and sexually
   d) Not known

6. **What is the proper sequence in reef formation?**
   a) Fringing reef, barrier, atoll
   b) Barrier, fringing reef, atoll
   c) Atoll, barrier, fringing reef
   d) There is no set sequence

7. **The animal part of the coral is _____ and the plant part is _____.**
   a) Medusa, zooxanthellae
   b) Polyp, zooxanthellae
   d) Dinoflagellate, polyp
   d) zooxanthellae, polyp

8. **What is a major threat to coral reefs?**
   a) Man-eating sharks
   b) Climate change
   c) Pirates
   d) Zombies

9. **Because of their amazing diversity of life, coral reefs are often referred to as:**
   a) The ocean's cupboard
   b) Rainforests of the sea
   c) Poseidonia's cornucopia
   d) Deserts of the oceans

10. **This is the only natural structure made by living organisms to be visible from space:**
    a) Belize Barrier coral reef
    b) The Great Barrier reef
    c) The Coral Triangle
    d) Red Sea coral reef

11. **When islands gradually sink into the sea due to volcanic activity they often leave behind circular reefs without any land in the centre. These reefs are known as:**
    a) Fringing reefs
    b) Barrier reef
    c) Double Barrier reefs
    d) Atoll reefs.

12. **India has about 5000 km² of its ocean under coral reef. Which of the following Indian land masses / islands do not have coral reefs formation?**
    a) Andaman & Nicobar Islands
    b) Lakshadweep Islands
    c) Coastal Orissa
    d) Gulf of Kutch

13. Corals are variously coloured. However, a few corals have been recently seen to develop white colour. This white color is due to

a. White coloured zooxanthellae.
b. Loss of algae from corals due to sea water warming called coral bleaching
c. Discolouration of corals due to ocean acidification.
d. Genetic change

14. These animals are found in coral reef and are called earthworms of the sea. They are

a. Sea Anemones
b. Jelly fish
c. Sea Cucumber
d. Dugong

E	L	A	F	H	O	R	R	A	L	G	A	E
S	L	H	E	N	E	D	A	A	P	S	A	E
C	L	A	E	I	F	S	C	U	E	L	T	I
I	O	S	R	E	Y	I	E	T	L	U	O	S
M	N	R	E	G	P	S	S	E	A	G	L	P
V	A	R	A	O	L	O	H	H	E	N	L	O
B	A	E	R	L	A	T	L	A	G	O	O	N
L	N	E	O	B	N	D	N	Y	K	A	R	G
A	A	F	P	A	K	A	G	A	P	T	S	E
S	E	Y	X	Y	T	C	A	L	I	C	L	E
E	C	O	H	M	O	L	L	U	S	C	U	H
E	O	S	I	I	N	D	I	A	A	I	G	A
Z	H	B	R	J	E	L	L	Y	F	I	S	H

Answers to the Coral Quiz

1.	B	8.	B
2.	D	9.	B
3.	B	10.	B
4.	B	11.	D
5.	C	12.	C
6.	A	13.	B
7.	B	14.	C

RELATED MFF (INDIA) KNOWLEDGE PRODUCTS

MANGROVES: SOLDIERS OF OUR COASTS

MANGROVES: GUARDIANS OF THE COASTS

TOWARDS THE CONSERVATION AND MANAGEMENT OF MANGROVE ECOSYSTEMS IN INDIA

CORAL REEFS IN INDIA - STATUS, THREATS AND CONSERVATION MEASURES

COASTAL SUSTAINABILITY: LEARNINGS FROM MFF INDIA PROJECTS

To download visit: www.mangrovesforthefuture.org/india

Also visit: www.fishtalesindia.org

Glossary

Rainforests	Luxuriant, dense and highly biodiverse type of forests, found typically in tropical areas of earth with consistent and heavy rainfall pattern.
Ecosystems	A biological community of interacting organisms and their physical environment.
Invasive Species	Species, historically non-native to a region, that adversely affects the habitat/ bioregion they invade economically, environmentally, and/or ecologically. They may be either plants or animals and may disrupt by dominating a region or by causing loss of natural controls (such as predators or herbivores)
Invertebrates	An animal lacking a backbone (such as an arthropod, mollusc, annelid or a coelenterate) etc. The invertebrates constitute an artificial division of the animal kingdom, comprising 95 per cent of animal species and about thirty different phyla.
Endemic	A species, disease or condition regularly found only among particular people or in a certain area/region. A plant or an animal species is called endemic to a region only if it is found in no other region of the earth.
Symbiosis	Interaction between two different organisms living in close physical association, typically to the advantage of both.
Algae	A simple, non-flowering, and typically aquatic plant of a large assemblage that includes the seaweeds and many single-celled forms. Algae contain chlorophyll but lack true stems, roots, leaves, and vascular tissue.
Sea Water Salinity	Total amount of solid materials in grams dissolved in one kilogram of sea water when all the carbonate has been converted to oxide, the bromine and iodine replaced by chlorine and all organic matter completely oxidized.
Mangroves	A tree or shrub which grows in tidal, chiefly tropical, coastal swamps, having numerous tangled roots that grow above ground and form dense thickets.
Echinoderm	A marine invertebrate of the phylum Echinodermata, such as a starfish, sea urchin, or sea cucumber.
Limestone	A hard sedimentary rock, composed of calcium carbonate or dolomite, used as building material and is used in making of cements.
Ocean Acidification	Ocean acidification is the name given to the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of anthropogenic carbon dioxide (CO_2) from the atmosphere.

MANGROVES FOR THE FUTURE

Mangroves for the Future (MFF) is a unique partner-led initiative to promote investment in coastal ecosystem conservation for sustainable development. It provides a collaborative platform among the many different agencies, sectors and countries who are addressing challenges to coastal ecosystem and livelihood issues, to work towards a common goal.

MFF builds on a history of coastal management interventions before and after the 2004 Indian Ocean tsunami, especially the call to continue the momentum and partnerships generated by the immediate post-tsunami response. It initially focused on the countries worst-affected by the tsunami; India, Indonesia, Maldives, Seychelles, Sri Lanka, and Thailand, and expanded to include Bangladesh, Pakistan and Viet Nam. MFF will continue to reach out other countries of the region that face similar issues, with an overall aim to promote an integrated ocean wide approach to coastal zone management.

The initiative uses mangroves as a flagship ecosystem, but MFF is inclusive of all coastal ecosystems, including coral reefs, estuaries, lagoons, sandy beaches, sea grasses and wetlands. Its long-term management strategy is based on identified needs and priorities for long-term sustainable coastal ecosystem management. These priorities emerged from extensive consultations with over 200 individuals and 160 institutions involved in coastal management.

MFF seeks to achieve demonstrable results in influencing regional cooperation, national programme support, private sector engagement and community action. This will be achieved using a strategy of generating knowledge, empowering institutions and individuals to promote good governance in coastal ecosystem management.

Learn more at : www.mangrovesforthefuture.org / www.fishtalesindia.org

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