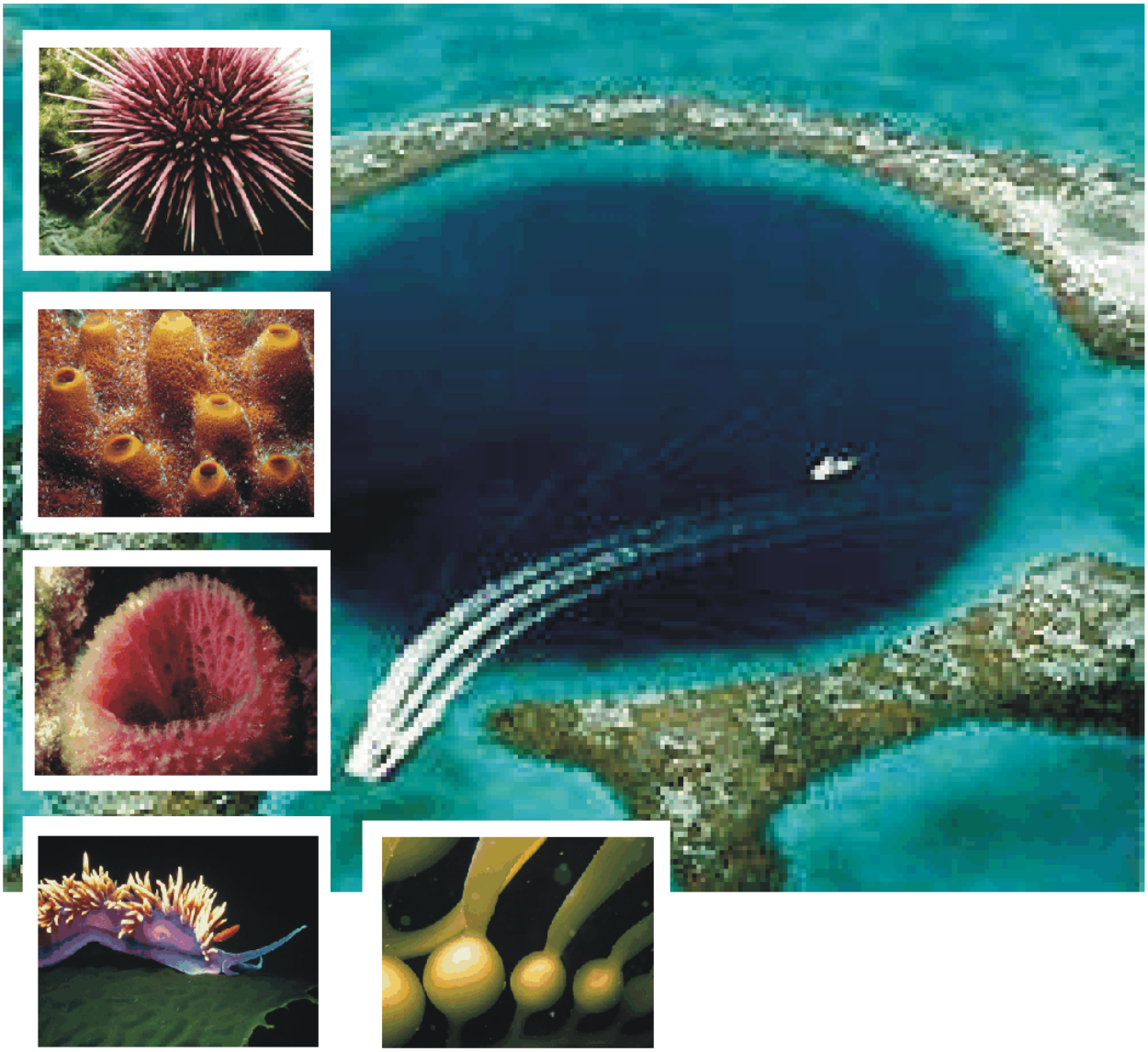
CORAL REEFS



What Are Coral Reefs?

The mention of coral reefs generally brings to mind warm climates, colorful fishes and clear waters. However, the reef itself is actually a component of a larger ecosystem. The coral community is really a system that includes a collection of biological communities, representing one of the most diverse ecosystems in the world. For this reason, coral reefs often are referred to as the "rainforests of the oceans."

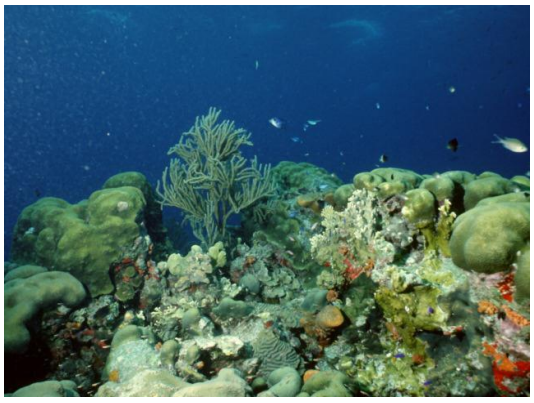
Corals themselves are tiny animals which belong to the group *cnidaria* (the "c" is silent). Other cnidarians include hydras, jellyfish, and sea anemones. Corals are *sessile* animals, meaning they are not mobile but stay fixed in one place. They feed by reaching out with tentacles to catch prey such as small fish and planktonic animals. Corals live in colonies consisting of many individuals, each of which is called *polyp*. They secrete a hard calcium carbonate skeleton, which serves as a uniform base or *substrate* for the colony. The skeleton also provides protection, as the polyps can contract into the structure if predators approach. It is these hard skeletal structures that build up coral reefs over time. The calcium carbonate is secreted at the base of the polyps, so the living coral colony occurs at the surface of the skeletal structure, completly covering it. Calcium carbonate is continuously deposited by the living colony, adding to the size of the structure. Growth of these structures varies greatly, depending on the species of coral and environmental conditions-- ranging from 0.3 to 10 centimeters per year. Different species of coral build structures of various sizes and shapes ("brain corals," "fan corals," etc.), creating amazing diversity and complexity in the coral reef ecosystem. Various coral species tend to be segregated into characteristic zones on a reef, separated out by competition with other species and by environmental conditions.

Virtually all reef-dwelling corals have a *symbiotic* (mutually beneficial) relationship with algae called *zooxanthellae*. The plant-like algae live inside the coral polyps and perform photosynthesis, producing food which is shared with the coral. In exchange the coral provides the algae with protection and access to light, which is necessary for photosynthesis. The zooxanthellae also lend their color to their coral symbionts. *Coral bleaching* occurs when corals lose their zooxanthellae, exposing the white calcium carbonate skeletons of the coral colony. There are a number of stresses or environmental changes that may cause bleaching including disease, excess shade, increased levels of ultraviolet radiation, sedimentation, pollution, salinity changes, and increased temperatures.

Because the zooxanthellae depend on light for photosynthesis, reef building corals are found in shallow, clear water where light can penetrate down to the coral polyps. Reef building coral communities also require tropical or sub-tropical temperatures, and exist globally in a band 30 degrees north to 30 degrees south of the equator. Reefs are

generally classified in three types. *Fringing reefs*, the most common type, project seaward directly from the shores of islands or continents. *Barrier reefs* are platforms separated from the adjacent land by a bay or lagoon. The longest barrier reefs occur off the coasts of Australia and Belize. *Atolls* rest on the tops of submerged volcanos. They are usually circular or oval with a central lagoon. Parts of the atoll may emerge as islands. Over 300 atolls are found in the south Pacific.

Coral reefs provide habitats for a large variety of organisms. These organisms rely on corals as a source of food and shelter. Besides the corals themselves and their symbiotic algae, other creatures that call coral reefs home include various sponges; molluscs such as sea slugs, nudibranchs, oysters, and clams; crustaceans like crabs and shrimp; many kinds of sea worms; echinoderms like star fish and sea urchins; other cnidarians such as jellyfish and sea anemones; various types of fungi; sea turtles; and many species of fish.



Why Are Coral Communities Important?

Coral reefs and their associated communities of sea grasses, mangroves and mudflats are sensitive indicators of water quality and the ecological integrity of the ecosystem. They tolerate relatively narrow

ranges of temperature, salinity, water clarity, and other chemical and water quality characteristics. Reefs thus are excellent sentinels of the quality of their environment. Proper monitoring of reefs can identify changes in water quality or impacts from land-based activities. Monitoring changes in water quality can help local resource managers understand the implications of actions occurring in watersheds that are associated with particular coral communities. These connections will help in development of sound management plans for coral reefs and other coastal and marine resources.

Man has had a long association with reefs. They are important fishery and nursery areas, and more recently have proved to be very important economically as tourist attractions. Reefs provide protection from erosion to coastlines and sand for beaches. However, reefs located near coastal populations are showing increasing signs of stress and are not faring as well as reefs which are more distant from centers of human population.

Coral reefs are important for many reasons. Most importantly, they provide protection and shelter for many different species of fish. Without coral reefs, these fish are left homeless with no where to live and no where to have their babies.

Not only do these fish increase the diversity of our world, but reef fish and mollusks feed between 30 and 40 million people every year. They also make beautiful pets and the money made by catching and selling these animals provides many people with an income so that they can feed their families.

And coral are very important in controlling how much carbon dioxide is in the ocean water. You read earlier about how the coral polyp turns carbon dioxide in the water into a limestone shell. Without coral, the amount of carbon dioxide in the water would rise dramatically and that would effect all living things on Earth.

In addition, coral reefs are very important because they protect coasts from strong currents and waves by slowing down the water before it gets to the shore. That is why they are called barrier reefs. They provide a barrier between the ocean and the shore.

What Problems Exist?

There are two types of stresses associated with reef systems: natural and human-induced. The effects of these stresses can range from negligible to catastrophic. Reefs display a surprising adaptation to short-term natural catastrophic events, such as hurricanes, and usually recover to normal community structure. These natural events can even

be considered beneficial in regards to biological diversity. Severe storm events on land can topple large trees. This opens up the forest to recolonization and results in a greater diversity of plants. This same process occurs with storm impacts to reefs. The damaged area of the reef is often recolonized by a greater diversity of organisms than existed before the storm. In the long term this event benefits the ecological integrity of the reef.

However, reefs are not well adapted to survive exposure to long-term stress. Some examples include agricultural and industrial runoff, increased sedimentation from land clearing, human sewage and toxic discharges. Many land-based activities have important implications for reefs. Agricultural activities can introduce herbicides, pesticides, fertilizers and runoff from animal feed lots. Sewage discharges can introduce nitrogen and phosphate compounds along with pathogens and mixtures of toxics. Uncontrolled land clearing can result in erosion, with the resultant increase in sediment loads to surface waters. Roadways, parking lots and buildings consist of impervious surfaces. These surfaces increase runoff rates and carry with those waters mixtures of dissolved substances to surface waters. The surface waters in any watershed eventually discharge into coastal or near-coastal waters. These waters can then impact coral communities associated with these discharge points. Thus, activities occurring in distant locations have impacts to reefs which are far away from these activities.

Ten percent of the world's reefs have been completely destroyed. In the Philippines (where coral reef destruction is the worst), over 70% have been destroyed and only 5% can be said to be in good condition. What has happened to destroy all of the reefs? Humans have happened.

There are two different ways in which humans have contributed to the degradation of the Earth's coral reefs, indirectly and directly. Indirectly, we have destroyed their environment. As you read earlier, coral reefs can live only within a certain temperature and salinity range. Global warming caused by the green house effect has raised the temperature of the oceans so high that the coral get sick and die (even a rise of one degree in the average water temperature can hurt the coral). Due to global warming, 1998 was the hottest year in the last six centuries and 1998 was the worst year for coral.

The most obvious sign that coral is sick is coral bleaching. That is when either the algae inside die, or the algae leave the coral. The algae are what gives coral its color, so without the algae the coral has no color and the white of the limestone shell shines through the transparent coral bodies. People have been noticing coral bleaching since the turn of the century, but only since the 1980s has it gotten really bad.

This mountainous star coral, Montastraea faveolata, from Panama has started to bleach.

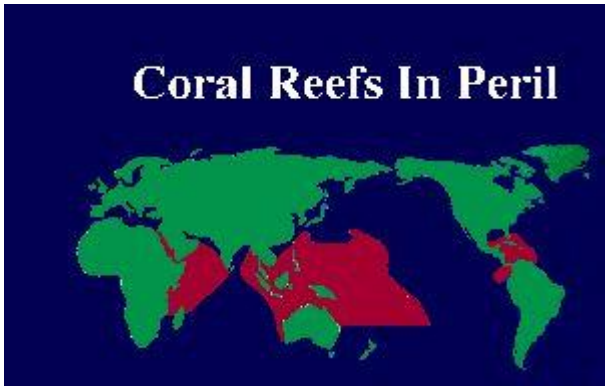
The warmer water also encourages the growth of harmful algae on top of the coral, which kills it, because it blocks out the sun. Without the sun, the zooxanthellae cannot perform photosynthesis and so they die. Without the zooxanthellae, the coral polyps die too. This algae is usually eaten by fish, but because of overfishing, there aren't enough fish left to eat all the algae. And the pollution we dump in the ocean is just what the algae needs to grow and be healthy, which means covering and eventually killing the coral reefs.

The direct way in which humans destroy coral reefs is by physically killing them. All over the world, but especially in the Philippines, divers catch the fish that live in and around coral reefs. They sell these fish to fancy restaurants in Asia and to fancy pet stores in the United States. This would be OK if the divers caught the fish carefully with nets and didn't hurt the reefs or take too many fish. But the divers want lots of fish and most of them are not very well trained at fish catching. Often they blow up a coral reef with explosives (like in the picture below) and then catch all the stunned fish swimming around. This completely destroys the reefs, killing the coral polyps that make it as well as many of the plants and animals that call it home. And the creatures that do survive are left homeless.

Dynamite not only kills the fish that live in the reef, but the reef as well ■

Another way that divers catch coral reef fish is with cyanide. Cyanide is a poison. The divers pour this poison on the reef which stuns the fish and kills the coral. Then they rip open the reef with crow bars and catch the fish while they are too sick from the poison to swim away. This poison kills 90% of the fish that live in the reef and the reef is completely destroyed both by the poison and then by being ripped apart.

The map below shows the areas in the world where coral reefs are in danger.



All this may seem a bit depressing, but there are many groups in the world dedicated to saving the coral reefs. These groups work to educate people about the destruction of coral reefs. They lobby the United States Congress as well as the governments of other nations, trying to convince them not to buy fish that have been caught by destroying coral reefs. They encourage governments to crack down on pollution, both into the ocean and into the air, which causes global warming. They encourage visitors to coral reefs to be careful not to harm them. They even build artificial reefs to replace the reefs that have been destroyed

Some people help coral reefs by convincing governments to treat them with care. Other people help coral reefs by studying them. One way that people learn more about coral reefs is by slicing open dead ones and looking inside. The inside of a coral reef looks a lot like the inside of a tree (look at the picture below) and the lines mean the same thing. A person who studies tree rings is called a dendrochronologist. "Dendro" means tree, "chron" means time and "ologist" means person who studies, so dendrochronologist means person who studies trees through time. Dendrochronologists count the number of rings in a slice of a tree to see how old the tree was when it died. There is one ring for each year the tree lived. The dendrochronologist also looks at the size of the rings. A thick ring means that that year there was lots of food and it was a good year for the tree. A thin ring can mean that there was a drought that year or maybe the tree was sick. In the same way, oceanographers can look at the rings in a slice of coral and see how old the coral is and which years were good years and which were not. The more we know about coral the better we will be able to protect them for years to come.

The Solutions:

1. There have been passed laws to protect certain areas of Maldives where coral mining, sand mining, fishing, anchoring (unless in an Emergency), or any other acts which may cause damage or harm to the reefs are PROHIBITED. (Map Follows on the next page)
2. Increase awareness among the locals.
3. Do not buy souvenirs, ornaments or any other product of coral.
4. Encourage people to admire the beauty below the velvet blue.

Protected Marine Areas of the Maldives

The folowing Areas are protected under The Law
No: 4/93 Environment Protection and Preservation Act
Designated Protected Areas (No:10-C/99/38, dated 21st October 1999)
Designated Protected Areas (No: E/95/32, dated 1st October 1995

Raa Atoll
- Villigili Thila

Baa Atoll
- Dhigalihaa/Horubadhoo Thila

Laviani Atoll
-Kuredhdhoo Kandu
-Fushivaru Thila

Male' Atoll
-Makunudhoo Kanduolhi
-Rasfari Faru
-Giraavaru Kuda haa
-Dhekunuthilafalhuge Miyaruvani
-Gulhifalhu/Kollavani
-Thamburudhoo thila
-Gaathugiri/Adhdhashugiri
-Emboodhoo Kanduolhi
-Guraidhoo Kanduolhi
-Lankan thila

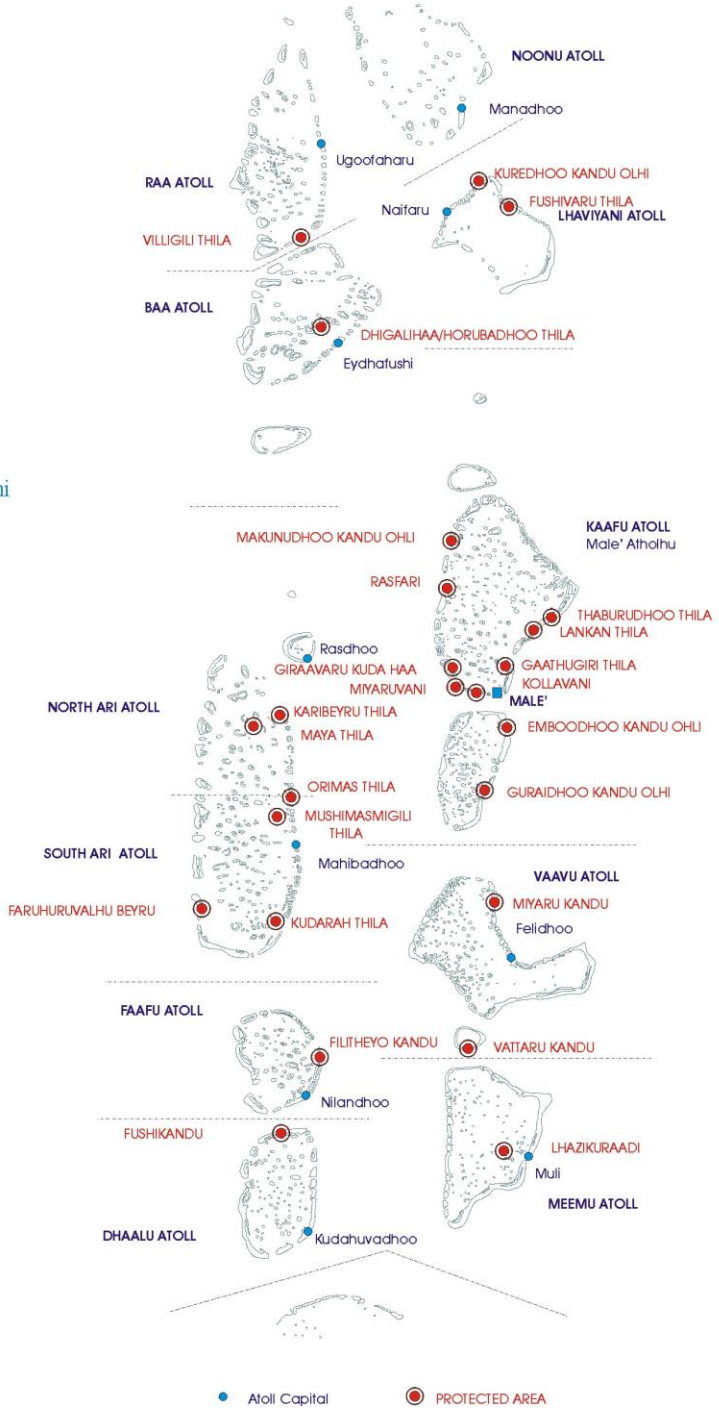
Alifu Atoll
-Maya Thila
-Orimas Thila
-Mushimasmigili Thila
-Karibeyru Thila
-Faruhulhuvaru Beyru
-Kudarah Thila

Vaavu Atoll
-Miyaru Kandu
-Vattaru Kandu

Meemu Atoll
-Lhazikuraadi

Faafu Atoll
-Filitheyo Kandu

Dhaalu Atoll
-Fushi Kandu



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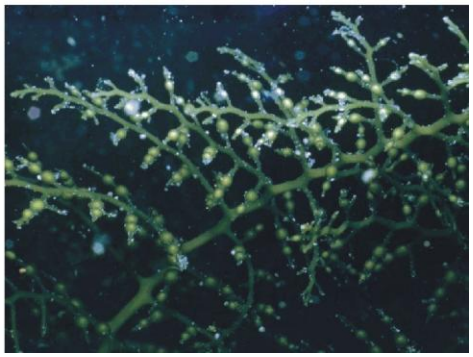
Photos:







Sources:

1. Moahemd Zahir (Ecocare)
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3. Ali Lishan
4. psrc.usm.edu
5. environment.gov.mv

Design and Layout:

Ali Lishan