

The Coral Reef Primer

CORAL REEFS ARE LIVING, BREATHING ORGANISMS THAT ARE THE FOUNDATION FOR ALL LIFE BENEATH THE WATER



▲ Inside the lagoon a coral bommie grows toward the surface. The limitation on the growth of these corals is the water level; which explains why the corals have all grown to about the same height.

► Vibrant, shallow coral reefs in Menjangan National Park, Bali. These reefs have been hit hard by dynamite and cyanide fishing in the past, but are starting to blossom under new management protection. Large *Acropora* table corals are a joy to see.

For many people, the coral reef is a simple structure seen while walking the beach at low tide or snorkelling just offshore. They see a vast array of life, from hard corals, soft corals, sponges, anemones, small reef fish, algae or sea grasses and, if lucky, an octopus or starfish. These organisms play an important role in the coral reef ecosystem and are key to its survival. But the reef is far from simple.

In Southeast Asia, the “Coral Triangle” – bounded by Indonesia, Papua New Guinea, and the Philippines – is the area containing the highest marine biodiversity on the planet. The epicentre of this area is the Raja Ampat region of Indonesia. In 2006, scientists documented in one location over 1,200 species of fish and over 600 species of coral. The coral reef is city, state, and country for all life in the oceans.

Formation

Coral reef ecosystems could not exist without hard corals, which are the reef builders, providing the building blocks and substrate from which all other life on the reef can grow. By day, hard corals generate energy by allowing tiny zooxanthellae – a symbiotic algae – to photosynthesise, essentially offering a trade of space inside their protective calcium structure in return for a free lunch.

The energy gathered from zooxanthellae actually provides about 90 percent of the energy requirement of corals. This, in effect, requires corals to live in the “euphotic zone” of the water column. The euphotic zone is the depth in water where enough light is present to allow photosynthesis to occur. This limits hard coral growth to around 60 metres in clear water.

The remaining 10 percent of their energy is in the form of drifting plankton caught by tiny nematocysts. Nematocysts can be crudely described as miniature harpoons, which are part of each individual coral polyp – as soon as any plankton touches the nematocyst, it discharges and grabs it. Over many years the corals gradually lay more calcium carbonate in their structure and grow toward the water’s surface.

Coral reefs can be split into several distinct groups based on their size and shape: fringing reefs, barrier reefs, and atolls. The most common type in Asia is the fringing reef.



A fringing reef is characterised by being attached to land, and separated from it by a shallow lagoon. A barrier reef is similar in its design to a fringing reef, just much larger and separated from land by a much deeper and larger lagoon. Atolls are typically circular reefs with a lagoon in the middle – there is usually little or no land in an atoll, and if there is it seldom reaches higher than five metres above sea level. There are many smaller types of reef too, often inside the lagoons created by the larger reefs.

Biodiversity

Biodiversity on a coral reef is immense. To break it down into bite-sized pieces (pun intended!) requires a quick explanation of the food web, to show how all species on the reef are in some way dependant on each other.

Fish, starfish, and numerous other animals feed on the hard corals. Invertebrates – those animals without a backbone – and soft corals live on the dead skeletons of hard corals, in order to catch planktonic food in the current.

Quite simply, big fish eat little fish. Which helps the hard corals as there is less grazing pressure upon them. It is by no means a linear relationship though. Sharks and large predatory feeders remove the weak and sick animals from the equation, thus helping prevent the spread of disease or continuation of undesirable genes.

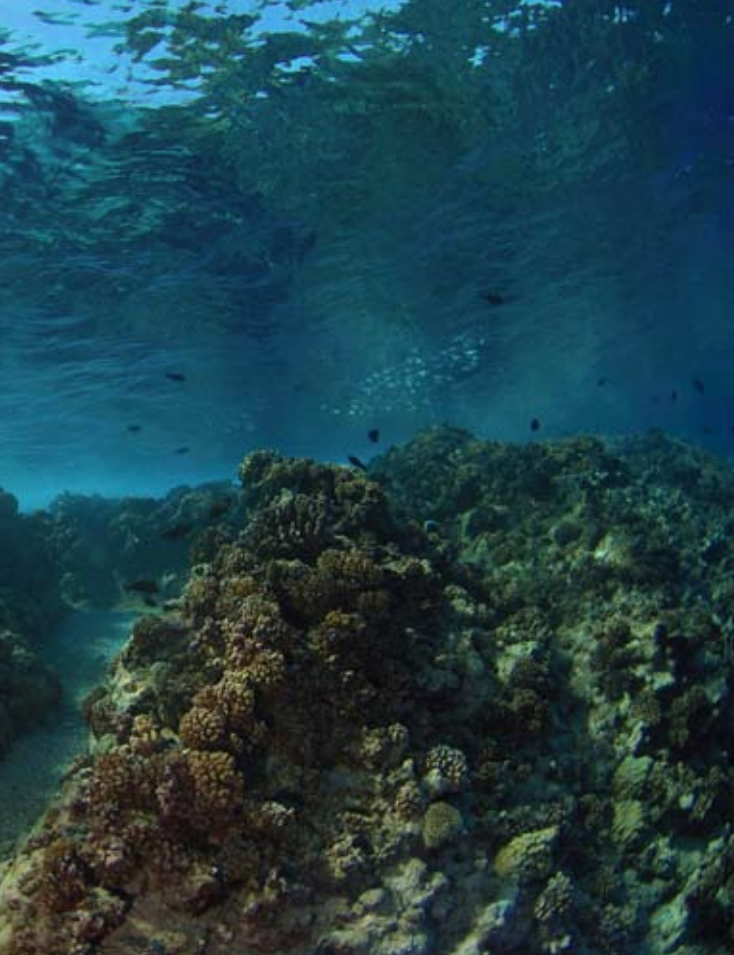
The cnidarians are an interesting group, encompassing benthic (or deep water) anemones, some corals, and pelagic jellyfish. They use passive predation on things that drift into them, using their stinging nematocysts to immobilise the prey.

Another familiar reef inhabitant is the sponge. Sponges constantly filter out plankton and detritus from the water column, and often provide shelter for other organisms in their vestibular structures. Crabs, shrimps, and lobsters assume many roles, from a general “garbage service” eating dead organic matter, to predatory stomapods with specialised appendages evolved to catch different prey. Cephalopods, such as octopus and cuttlefish, are highly intelligent predators, hunting for a tasty morsel – those very same crabs and shrimps – in every nook and cranny on the reef.

▶ A section of reef inside a lagoon recovering from the ENSO event in 1997. The small hard corals are beginning to cover almost all of the reef that died seven years before; however, it will be some time before they reach the magnificent size of the previous generation.

▶ A lionfish (*Pterois volitans*) searches for glassfish on this healthy section of inner lagoon reef. In this photograph there are over 20 different species of marine organism!





The Future

Sadly, the future for the world's coral reefs is bleak. It is estimated in some areas such as the Philippines and Indonesia that up to 80 percent of the corals have disappeared in less than 100 years. There are many pressures on the reef including environmental catastrophes, human pressures, and global warming.

Perhaps the greatest pressure is poor water quality, caused by runoff from land. The silt washed away from rainforests due to logging interests makes the coastal water so dirty that hard corals cannot obtain the energy they need from the sun, and begin to die. Once hard corals die off and disappear, the diversity of the reef plummets. The "eutrophication" from agricultural runoff and human sewage can cause algal blooms, which can also choke the reefs from their supply of energy.

The 1998 and 2004 El Niño-Southern Oscillation (ENSO) events were a huge blow to the world's reefs. Rising sea temperatures caused the zooxanthellae to leave the safety of their coral castles, leaving the hard corals with only around 10 percent of their usual energy intake. (This is sometimes referred to as "bleaching", as the corals turn white.)

A more direct human cause is fish collection. Fishermen in Indonesia and the Philippines use sodium cyanide to catch fish for the aquarium trade. Setting aside the fact the fish often die on the way to the hobbyist, the area where the cyanide has been used becomes a virtual graveyard. With no grazing fish around, algae grows out of control, suffocating the hard corals that managed to even survive the cyanide. Fishing for food with dynamite is another problem in Asia. Thankfully, with education there are fewer craters being created on the reefs.

An up and coming problem, and one that is in the news almost daily, is global warming. Higher temperatures mean ENSO events are more likely to occur, and rising sea levels may kill off deeper sections of the reef. Finally, a new worry is "ocean acidification". The increased carbon dioxide in the atmosphere is making the sea more acidic. Acidic water dissolves the coral structures, making it much harder for them to grow and survive.

With over 500 million people in Asia dependant on coral reefs for sustenance, it is imperative we do all we can to keep them healthy for future generations. Thankfully, though coral reefs are complex structures a complex solution is not required. Just a little education. And a lot of action. ■

Did you know

Electric Reefs

In Pemuteran, Bali, and Gili Trawangan, Lombok, there is an unusual type of reef: it is man-made. These artificial reefs were constructed to restore damaged reefs and provide places for fish to grow and breed.

The process begins by constructing a large steel frame. The structure is placed in shallow water, and a small electric current passed through it from wires that are run from the shore. The structure becomes the cathode in the electrical circuit, with a highly specialised anode in the water nearby. Due to the composition of seawater, calcium deposits occur on the cathode – the reef structure – over time. In just a few months the structure is unrecognisable, coated in limestone as hard as concrete.

This is an ideal substrate for new corals to colonise, but it is a slow process, taking many months to grow. Interestingly, scientists discovered that if you attach damaged coral to these electric reefs they recover more quickly and grow faster, with more resistance to temperature change and disease. This has led to many of these artificial reefs being constructed in areas that suffered damage in the 1998 ENSO event. To learn more visit the Global Coral Reef Alliance, which has developed projects like the electric reefs, visit www.globalcoral.org

(Read more about electric reefs in "It's Alive!", page 38)

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