POWER

PLANTS OF THE REEF

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CITIES UNDER THE SEA

THE EXPERIENCE OF MOST PEOPLE DURING THEIR FIRST DIVE ON A CORAL REEF IS COMPLETE BEWILDERMENT – A RIOT OF COLOR, ALIEN LIFE FORMS AND APPARENT CHAOS OF ACTIVITY.

With time, patience and a bit of homework one can begin to see method in this madness. Remarkably there are many activities and processes on a reef that can be most easily understood in the context of a human city. In this article and those that follow I will use the metaphor of human communities to illustrate some of the most fascinating and important aspects of coral reefs.

Energy is the currency of nature. No energy – nothing happens! Think of transportation, a light bulb, a star or your body – they all run on energy. A coal reef is one of the most energetically active ecosystems on earth, comparable to rainforests. Unlike our human cities though, reefs have no subsidy from petroleum or nuclear power, they run exclusively on solar power.

This is possible because almost all the surfaces of the coral reef are covered with solar collectors – various species of plants called algae. Corals have their own gardens of algae living inside their bodies. In fact, the form of many coral colonies is specially designed to promote efficient energy collection by algae. The high rates of productivity and efficiency of coral reefs are, in part, due to the architectural wisdom of corals themselves. Since sunlight comes down from above, solar collectors must be positioned on the top of the colony to receive it. To provide the greatest surface area for the absorption of sunlight, many corals flare into shapes resembling tabletops, arms reaching toward the sun, or leaves on a tree.

Other corals, called brain corals, employ a different architectural strategy. We humans, 'higher' mammals with brainpower, benefit from all the convolutions of our cerebrums. More convolutions mean more surface area for more cells to conduct more thinking. Likewise, corals need more surface area for more cells to collect more sunlight. Thus, we see an evolutionary convergence between very distantly related animals using similar strategies to meet similar needs.

Corals as Farmers

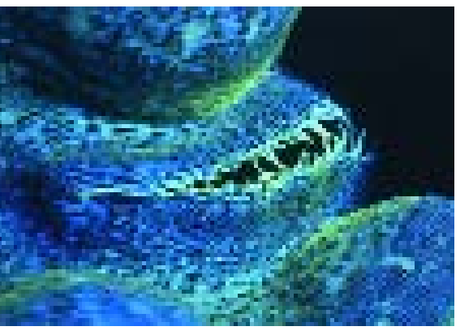
The shape of corals is only part of the story. As animals we could lie in the sun for weeks and never meet our needs from all of that solar energy raining down on us, we would just get sunburned and hungry. What we need is an intermediary – plants – that can convert solar energy into food energy, which then can be consumed by us. So in the case of corals, having a garden of algae inside their tissue is of great benefit.

The algae that live inside corals, remarkably, are relatives of the tiny critters that make the sea glow at night from bioluminescence. These light giving dinoflagellates have cousins that live inside corals called, zooxanthellae. This is a mouthful but can be useful to impress people at a cocktail party.

As we will explore in a future article, everything is efficiently recycled in the coral city. As animals, corals produce metabolic wastes, the byproducts of their using food, some of which comes from the algae in the first place. These wastes are the very nutrients algae need for growth. Thus, byproducts such as carbon dioxide, nitrogen, and phosphorus are efficiently recycled. The coral has its own wastes removed and the algae use it as fertilizer, helping the algae to convert more sunlight into more food. In some cases, as much as eighty percent of the food produced by algae may be released to the coral host. Oxygen produced during photosynthesis becomes another form of payment by the algae to the coral for the fertilizer, and the coral in turn provides the algae with a place to live. We know this relationship is important because

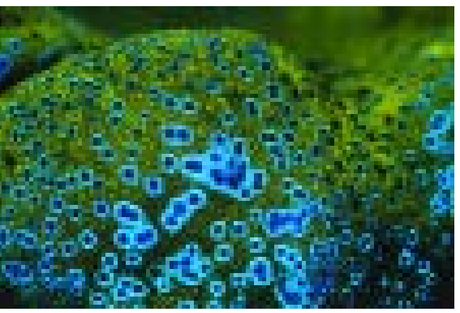
research has shown that zooxanthellae are necessary for a coral to construct their skeletons. When deprived of their algal partners the corals cannot make their skeletons and may eventually die.

Corals as Predators
The nutritional benefit of having algae live inside corals is only part of the story. Being animals, corals can prey on other external food sources as well. You, who diver at night have likely been 'swarmed' with all sorts of weird little critters that are attracted to your dive light. These critters are called demersal zooplankton, which means drifting (planktos) animals (zoo) that live in association with the bottom (demersal). More good cocktail words. This animal tissue, rich in nitrogen and phosphorus, serves as important nutritional supplements for the corals. Since the recycling involved in the coral-algae partnership is not perfect, feeding on demersal zooplankton makes up for any loss of nutrients. Have you ever noticed that most corals have their tentacles withdrawn in the daytime but extended at night? In daytime, coral tissue, which is full of algae, can be exposed directly to sunlight without coral tentacles getting in the way. At night, when there is no solar energy available, tentacles stretch out to capture plankton.

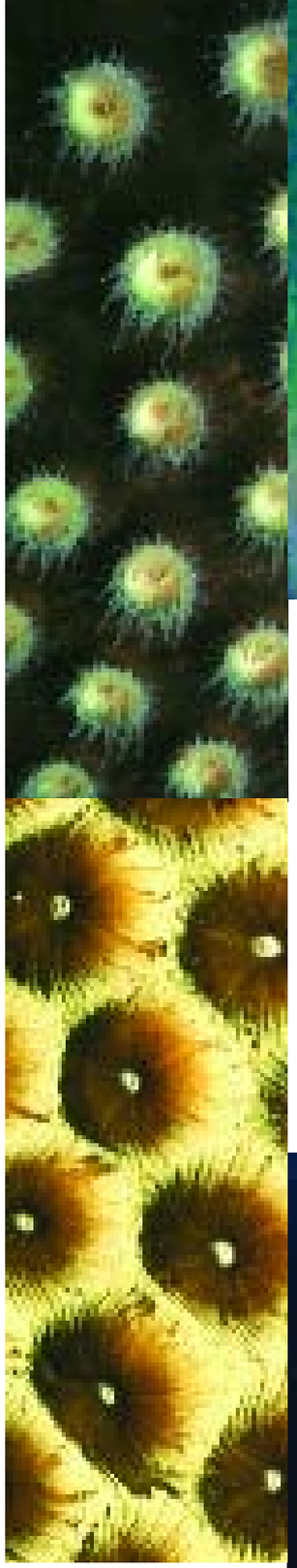


Corals are really the supreme opportunists since they also feed on non-living sources of food. Corals have been observed feeding on drifting particles of organic material, and they even absorb dissolved organic molecules. Thus, the marvellously ingenious yet 'simple', brainless corals employ incredibly efficient strategies of form and behaviour to make the best use of whatever source of food is available – day and night.

Other Reef Farmers
Corals are not the only farmers on the reef. Giant clams are the largest clams on the planet, thanks largely to the same partnership corals have with zooxanthellae. Called man-eaters by some, giant Tridacna clams live peacefully and, like the corals, feed on algae and also filter plankton from the water, as do most bivalves. Compared to other clams, the soft mantle of this giant clam, which constructs or secretes the shell, is greatly expanded.



The zooxanthellae reside in this mantle tissue. Thus, with more mantle there is more surface area for more algae to absorb more sunlight and make more food. These clams even have small lens-like structures (ocelli) in their



mantle through which light penetrates, giving even more light to more algae. Who said clams were boring?

So, we see a remarkable convergence in strategies employed by corals and giant clams. Both grow in forms to provide a greatly expanded surface for their algal gardens to capture sunlight, and both employ recycling of animal waste to help fertilise the algae. As with the coral-algae relationship, the recycling of nutrients is essential to maintaining productivity by the algae in the clams.

Solar collectors everywhere
Actually much of the reef 's surface has the appearance of being relatively denuded, but in reality it is covered with algae – in some cases, with a thin veneer of pink algae, like a layer of cement covering the bottom. These coralline algae cover most surfaces on the reef where corals are not living. Coralline algae are very important because they are the mortar that binds reef fragments together and solidifies the reef into one durable structure. In fact, some scientists have suggested that coral reefs be called algal reefs, since in some regions algae may be as important in reef formation as are the corals themselves.

Were our human communities so efficient! Imagine roof top gardens, streets lined with fruit trees and vegetable gardens, all fertilised by our own sewage in such a way that pollution issues disappear. By now you ought to be sufficiently energised to call up your travel agent and discover for yourself the architectural wonders of the coral reef.

Based on *Coral Reefs – Cities Under the Sea* by Richard Murphy