SL 305

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The Importance and Status of Florida Coral Reefs: Questions and Answers[1]

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Introduction

Coral reefs are some of the most productive and diverse, but threatened, ecosystems in the world. Here we address some of the most common questions regarding coral reef biology, coral reef health, and the ecological and economic benefits coral reefs provide.

Q: What are coral reefs?

A: Although coral polyps are closely related to jellyfish and sea anemones, they are able to form majestic rock-like structures of varying shapes and colors. These structures are the calcium carbonate skeleton, which is secreted by the coral polyps. Typically the growth rate of this skeleton is rather slow (0.5 to 2 cm per year), but favorable conditions can lead to more rapid growth. Coral reefs are limited by environmental conditions (especially temperature) and are typically found near the equator, although corals belonging to the genus *Lophelia* thrive in the deep ocean as far north as Norway.

Q: What *exactly* is a coral?

A: Thoughts of a "coral," whether in aquaria or in the ocean, bring to mind images of brightly colored, sedentary organisms. Each structure is a colony, made up of a few to thousands of individual polyps. Not unlike their relatives (jellyfish and sea anemones), corals are "symbioses" (mutually beneficial associations), consisting of an invertebrate animal (polyp) living with its algal and bacterial partners. In this relationship, the coral polyp provides a protective environment and the symbiotic algae fix dissolved CO_2 through photosynthesis to produce carbohydrates (food) that the coral animal can use. It is the loss or expulsion of their algal symbionts (called *zooxanthellae*), that leads to a loss of color referred to as "coral bleaching." The roles of bacteria in this symbiosis are much less clear; they are hypothesized to fix atmospheric nitrogen for their polyp and algal hosts, but they may also produce various antibiotic compounds that function to protect against infection.

Coral polyps are capable of capturing food using their tentacles (suspension feeding), and they also

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derive carbohydrates from their symbiotic algae. Carbohydrate that is not used directly by the animal is excreted onto the coral surface in the form of mucus. Coral mucus mostly consists of carbohydrates and proteins. Mucus can protect the coral from damage caused by ultraviolet (UV) irradiation, drying at low tides, and harmful bacterial colonization.

Q: Why are coral reefs important to economies?

A: According to the United Nations Atlas of the Oceans, reefs support economies of at least 100 countries by providing food for more than 1 million people. While corals are not edible themselves, coral reefs provide habitat for fish and lobster. Mucous slime secreted by the corals is high in polysaccharides and proteins and is an important food source for plankton, which–-in turn–-is consumed by commercially-harvested fishes. In addition to providing food and habitat for fish and lobster, coral themselves are explored for their medicinal properties. Chemicals purified from corals have promising anti-cancer and anti-bacterial properties. The estimated value of the planet's coral reefs is $375 billion/year.

In Florida, coral reefs contribute at least $2.9 billion to local economies annually and directly provide employment for 39,000 people. Florida reefs are a major tourist attraction; for example, visitors spend $460-1,087/person/trip. Florida coral reefs provide habitat for more than 4,000 fish species and support commercial and recreational fishing industries that generate approximately $60 million. Such "user value" of Florida reefs was estimated to be $8.5 billion.

Q: What factors have led to coral reef decline world-wide?

A: Extensive coral mortality can be caused by catastrophic natural events (storms, hurricanes, volcanic eruptions). Ship groundings, boat anchor damage, poaching, and damage to corals from recreational diving can significantly and adversely impact coral reef ecosystems, especially in densely populated coastal areas like Florida. An increase in sea surface water temperatures–even a single degree–can stress corals and lead to their decline. Recent research has focused on the roles of coral bleaching, coral disease, coral predators, and the loss of reef herbivores in reef health.

Q: What is Coral Bleaching?

A: Coral bleaching is the loss of color resulting from the loss or expulsion of symbiotic zooxanthellae or degradation of their photosynthetic pigments. Left without their symbiotic algae, the corals appear white (the color of the calcium carbonate skeleton) and often die, as they cannot obtain the necessary nutrients without their symbionts.

Coral bleaching generally occurs in times of stress, often caused by warm sea surface temperature or UV radiation from the sun. When stressed, coral polyps actively expel algae. When environmental conditions become favorable later on and a suitable strain of algal symbiont is present in the environment, the corals may re-acquire a new zooxanthellae partner. Through re-acquisition of a more stress-tolerant zooxanthella, a coral colony may successfully recover from bleaching. The appearance of coral bleaching could also be caused by pathogens, which produce toxins that can either stress or poison algal photosynthetic pigments.

Q: What are coral diseases and where do they come from?

A: Many organisms that cause coral diseases are not dedicated pathogens, but are opportunistic. Opportunistic pathogens are those that are normally found in the environment and are generally benign. These pathogens invade their hosts only when the host defense system is compromised. Coral diseases caused by opportunistic pathogens are now widespread. Several of these that cause devastating diseases of corals were recently identified. The discovery of a pathogen (*Serratia marcescens*) found in human waste prompted research on the role of human activities in coral reef health. While this observation is important, conclusive evidence that wastewater is reaching and adversely affecting coral reef environments along the Florida Keys is limited. Furthermore, strains of *Serratia* are often isolated from environmental sources that are free of human waste.

Q: How do human influences affect the health of Florida's coral reefs?

A: Human activities and their direct and indirect outcomes can impact coral reef ecosystems. Although these ecosystems may recover from natural disasters, their ability to recover from human impacts is less certain. Unlike natural disturbances like hurricanes, the effects of human activities are often sustained, cumulative (e.g. nutrient enrichment and pollution), or occur so frequently (e.g. overfishing) there is little time for reefs to recover.

Global climate change is regarded as one of the major threats to the future of coral reefs because temperature increases of only a few degrees induce global-scale coral bleaching episodes and mortality. Warming water is the leading cause of coral reef decline and it increases outbreaks of marine disease. If trends continue, atmospheric carbon dioxide concentration will increase and the pH of ocean waters will decrease. These changes will increase stress to corals and increase their susceptibility to bleaching and disease.

Through human activities, corals are exposed to increasing nutrient, sediment and pollutant loads discharged from the land, which drastically alter the dynamics of the reef ecosystem. Massive seaweed blooms result from nutrient enrichment of otherwise nutrient-poor waters. These blooms outgrow seagrass and adult corals, inhibit recruitment of juvenile corals, and may lead to a decrease in oxygen availability. Corals may also be out-competed by other filter feeders (e.g., sponges, bivalves, ascidians, bryozoans, and barnacles), which are more efficient at utilizing particulate organic matter.

Nutrient enrichment also directly influences the dynamics of the coral-zooxanthellae symbiosis. Zooxanthellae density increases in response to high concentrations of dissolved inorganic nutrients (e.g., nitrogen and phosphorus). The algae use nitrogen for their own growth rather than growth of host tissue. The subsequent increased density of zooxanthellae takes up more carbon dioxide compared with that occurring under non-enrichment conditions, which then decreases the carbon dioxide available for coral calcification. Increased particulate organic matter (e.g., clay and organic particles suspended in the water) also indirectly influence corals by reducing light penetration to the zooxanthellae. If prolonged, this may lead to lower carbon gain by the coral from zooxanthellae photosynthesis, slower calcification rates, and thinner coral tissue.

Q: What can Floridians do to help maintain health of coral reef ecosystems?

- Educate yourself about coral reefs. Learn about coral reef research carried out by the Florida Department of Environmental Protection (http://www.dep.state.fl.us/coastal/habitats/coral.htm), Florida universities, and not-for-profit research organizations (http://www.mote.org, http://www.flaquarium.org; http://floridakeys.noaa.gov/eco_discovery.html).
- When diving, snorkeling and boating around coral reefs it is important not to damage the corals by touching them, standing on them, or using them for anchoring.
- Do not participate in illegal trade or harvest of corals.
- Be a responsible fisherman: follow the guidelines for saltwater fishing http://www.myfwc.com/RECREATION/Saltwater_index.htm.
- Help reduce nutrient run-off: reduce the use of fertilizers on lawns and landscapes; consider planting native ornamental species that can reduce the need for fertilization and watering; consider using iron-containing supplements for lawns in place of fertilizers containing high amounts of nitrogen and phosphorus.

These simple steps can help us contribute to the preservation of our unique coral reef ecosystems!

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