Natural History of Coral Reefs

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**Introduction**

 Of all the marine ecosystems, coral reefs can be referred to as the most diverse. Most of the species that live in an ocean depend on the coral reef for shelter and food. This is surprising given the fact that coral reefs only occupy a small fraction of the earth's surface and less than 2 percent of the ocean (Dunne, 2009). Coral reefs are commonly referred to as rainforest of the sea because of their diversity. Coral reefs are also essential to human beings. They are estimated to be worth 30 billion U.S. dollars and 172 billion U.S dollars annually (Stathakopoulos & Riegl, 2014). They provide food, medicines, attract tourism and also protect the shorelines. However, people have become a threat to coral reefs (Robertson, 2015). Various activities carried out by human beings affect coral reefs. These activities include overfishing and pollution. These activities have led to the destruction of coral reefs while other coral reefs have been reduced to a shadow of themselves.

**What are coral reefs?**

Sea anemones are known to be related to corals since they have similar skin structure which is referred to as the polyp. The poly usually looks like a can that is open at one end. The open end is generally surrounded by what looks like a ring of tentacles. The tentacles have stinging cells, which are usually referred to as nematocysts, which help the coral polyp to capture organisms that come close. The polyp usually contains reproductive and digestive tissues (Stathakopoulos & Riegl, 2014). However, corals are different from sea anemones form the way they develop a mineral skeleton.

Corals located in shallow waters and live in warm waters are thought to have another source of food, which is usually referred to as the Zooxanthellae. This kind of algae is known to photosynthesize. It makes its food from the sun's energy and passes it to its host while it also receives nutrients from the coral animal (Dunne, 2009). This relationship makes corals that are located in shallow waters to grow faster, building some enormous structures which are referred to as reefs. The zooxanthellae are known to provide various colours such as red, brown and green, which are found in coral reefs (Stathakopoulos & Riegl, 2014). However, other colours that are common in coral reefs such as blue, mauves and purple are made by the coral reefs themselves.

In the 1960s, some scientists decided to study the inner working of the Caribbean coral reefs. To explore this complex ecosystem, the scientists needed to set a field station (Wells, 1995). In 1972, they found an island with some shuttered building (Wells, 1995). They decided to set the work station in the area. Up to date, Carrie Bow Cay, which is located in Belize, still hosts the Caribbean coral reef ecosystem program (Wells, 1995).

**History of coral reefs**

The current and future state of coral reefs can be only be compared with an overview of the evolution (Robertson, 2015). When we compare the historical and contemporary coral reefs, we can quickly come up with strategies for conserving coral reefs in the future. Coral reefs are of different forms and shapes, and they were discovered many years ago. About 3.5 billion years ago Microbialites began to appear in the fossil record. For the next 2.5 billion years, Microbialities ware replaced by stromatolites (Robertson, 2015). These organisms produced boulder-like structures, which are known as the oldest examples of coral reefs. However, stromatolites still exist in various parts of the world. They are found in areas where sedimentation rates are high, and the nutrients level is very low. The Bahama banks, which are found in western Australia, are the commonly known stromatolite reefs. The stromatolites have always been the primary reef-building organism up until the pre-Cambrian era. After this, a greater diversity of reefs began to evolve, and various reef communities began to take shape. For the past 600 million years, reefs have undergone three cycles of development. All reefs are known to evolve based on the marine extinction.

The first cycle dated back from the pre-Cambrian to the mid-Cambrian. It was characterized by stromatolites, calcareous cyanobacteria, algae and Archaepcyathids. The second cycle started from the mid-Cambrian to the late Devonian (Robertson, 2015). Some of the reefs commonly associated with this phase were the Algae -sponge coral tripartite and the specific coral involved in these associations were widely known as the ancient rugose corals. However, in this phase, stromatoporoid, cyanobacteria and molluscs were also present. The communities found this era were complex and diverse. The third cycles date back from the late Devonian to the Late Permian. This phase was mostly dominated by algae-bryozoan-coral assemblages. Other reefs present were stromatoporoid, foraminifera, rudist, cynabactreaia, sponges and phylloid algae. From the third phase, corals have become dominant reef builders.

**What caused extinctions and evolutions in coral reefs**

 Several hypotheses caused Extinctions and evolution of various coral reefs. However, the combined effect of ocean chemistry and changes in temperature are thought to have caused the extinction of multiple species in the ocean. The continental drift combined with other tectonic events changed the world oceans in terms of salinity, temperature and dissolved oxygen. The rapid rise of sea level may have caused the drowning of reefs in some areas. Other factors that may have contributed to a change in the global climate were the extraterrestrial explanations. The threats exposed to coral reefs in the same threat exposed to other marine species as a whole. In recent years disturbances in coral reefs are being recorded daily at an increasing rate. Many sources of environmental stress on coral reefs have significantly increased, especially in shallow tropical seas (Robertson, 2015). This environmental stress can be classified as either anthropogenic or natural. However, this distinction may continue becoming more artificial as we continue to understand the complex nature associated with the ecosystem of coral reefs. However, human influence can still be distinguished in the disturbance of coral reefs. The early laboratory studies showed that there was little harm to coral reefs unless they were exposed to oil. However, various studies have shown that there has been highly reduced reproduction and increased mortality of coral reefs (Robertson, 2015).

Coral mining is thought to have caused significant effects of coral reefs in areas such as in South Asia and the Indian ocean. On the other hand, sedimentation is another threat to coral reefs. It is usually brought forth by shrimp farming, drilling mud erosional runoff dredging activities and logging.

**Eutrophication**

This can be termed as the increase of inorganic phosphate and nitrate (Fields, 2010). It has been termed as a significant threat to coral reef communities, which are near expanding human populations, especially in coastal areas. The world population has exceeded by 6 billion, and it is expected to double by 2050 (Stathakopoulos & Riegl, 2014). However, most of this increase in population is being experienced in developing countries, which are mainly located in southeast Asia, where sizeable marine biodiversity exists (Dunne, 2009). However, most of these studies have been carried out in queens land and Florida. Effects of eutrophication cannot be predicted easily because of the way the reef community-levels respond to various affected areas (Stathakopoulos & Riegl, 2014). For example, between 1963-1977, Kaneohe Bay, which is an Island located in Hawaii, discharged sewage, which had a peak flow rate of 19000 cubic meters a day (Dunne, 2009). An increase in particulate load, which comprised of zooplankton and phytoplankton and soluble nutrients, caused various changes in the reef community structure. By 1974 coral reefs had been dominated by green algae, which were known as the Dictyosphaeria cavernosal and by 1977, sponges barnacles and zoanthids had become dominant invertebrate taxa (Fields, 2010).

**Coral diversity**

 Stony coral reefs are composed of tropical coral reefs. Each polyp has a cup that is made up of calcium carbonate. Stony corals are the most remarkable reef builders, because blue corals, precious red corals and organ pipe corals all have stony skeletons. Other corals are known to use tiny stiff rods to build the skeletons; they include black corals, sea rods, and soft rubbery corals. However, the family tree of coral reefs is complicated. Some groups are related, while others differ significantly.

**Reproductions**

Corals have many reproduction systems. Corals can either be male, female or both. Their reproduction is either sexually or asexually. Asexual reproduction helps in increasing their colony while sexual reproduction helps them to increase their diversity by starting new colonies, which are far related to the parents.

**Asexual reproduction**

Asexual reproduction brings about colonies or polyps, which are clones of each other. This is made possible through fragmentation or budding. Budding happens when a certain coral polyp reaches a certain size, which causes it to divide, thus producing an identical polyp genetically. Corals are known to do this across their lifetimes (Glynn, 2016). Sometimes a specific colony may break off, thus forming a new colony. This is usually referred to as fragmentation, which is brought about by the disturbance caused by fish equipment or a storm.

**Sexual reproduction**

 When it comes to sexual reproductions, eggs have to be fertilized by a sperm from another colony and develop into a free-swimming larva (Glynn, 2016). Corals have two types of sexual reproductions which are either internal or external (Dunne, 2009). The larva looks for a substrate depending on the type of fertilization and species, and after a few days or weeks, they usually become polyps (Glynn, 2016). However, some stony corals are referred to as broadcast spawners where fertilization occurs externally. Colonies are known to produce many numbers of sperms and eggs, which are usually in the form of buddies and float along the surface. Spawning is known to occur only once a year, depending on the species. Spawning also occurs at night, and it is usually an interesting occurrence. However, some corals are known to brood their eggs in the polyp and release them into the surface. As the sperm tend to sink, those corals that have the eggs usually absorb them in, and fertilization occurs. Coral brooders can produce sperms severally, and fertilization occurs many times in a year.

**From corals to reefs**

Coral polyps found within a reef are usually very small in number (Fields, 2010). The largest polyp is known to be found in mushroom corals and is known to be more than 5 inches. Since corals are usually in colonies, the size of a colony is generally larger. Big mounds are equalized to a small car, while a single branching colony can cover a whole reef. Reefs made of many colonies are bigger as well. The largest coral reef is usually known as the Great barrier reef, which covers about 1600 miles and is normally found on the east coast of Australia. Reefs are known to be formed out of corals in shallow waters near smaller islands or continents. Most coral reefs are usually fringe reefs because they are normally found in the coastline of a landmass, which is nearby (Glynn, 2016). However, when coral reefs grow around some volcanic islands, a surprising thing occurs. Over many years the volcano my sink gradually while corals continue growing upwards on the surface and outwards towards the open ocean. After some time, some lagoons usually form between the sinking island and the corals, while a barrier reef often forms next to the lagoon. After some time, the volcano may be submerged, and the corals remain. This is usually known and atoll. It takes years before a big coral colony emerges (Dunne, 2009). This is because corals typically grow slowly. The fastest-growing coral is known to expand at 6 inches annually. Reefs typically grow at a slower rate than that, especially when corals die. They usually divided themselves into smaller units and became more complicated. These colonies can live for centuries or decades. Some of the dep sea colonies have lived for about 4000 years; you can discover this through annual rings that corals have. These skeletons can easily explain the environmental conditions at sea about thousands of years ago.

**Where can we find Reefs**

Coral reefs are usually found at the oceans and seas across the globe, both in shallow or deep water. While reef-building corals can only be found in some shallow subtropical or tropical waters (Glynn, 2016). This is because algae present in their tissues usually need some light to carry out photosynthesis. The water temperature preferred by coral reefs is usually 70-85°F to 22-29°F

 Some deep-sea corals are found cold dark water with a depth of about 20000 feet. For example, the soft corals and the stony corals are usually located in deep seas (Robertson, 2015). Corals, located in deep seas, do not need sunlight or warm water to survive (Glynn, 2016). However, deep-sea corals usually grow slowly as compared to those corals growing in shallow waters.

**Reefs as ecosystems**

Reefs can be referred to as big cities of the sea (Fields, 2010). When corals are small, they are usually eaten by various animals. However, they are less tasty once they settle down or their skeleton forms (Robertson, 2015). Some fish, snails, worms eat the adult corals. One of the species that prey on coral reefs is the crown of thorns sea stars (Stathakopoulos & Riegl, 2014). The high population of these predators makes one reef to be filled with many of these starfish. They usually cause the death of some coral reefs. Coral reefs are also known to have competitors (Fields, 2010) . Some competitors of coral reefs are known as nematocysts. Nematocysts are known to compete with coral in terms of food as they are also known to sting the surrounding coral reefs and to keep them at bay. Seaweeds and animals are known to be the most significant competitors (Stathakopoulos & Riegl, 2014). Nematocysts grow faster as compared to coral reefs. They also have a nasty chemical that is known to injure the coral.

However, coral doesn't rely on themselves for defence because they have some beneficial relationships with the zooxanthellae. Some other coral colonies are known to have shrimps and crabs within their branches, thus defending themselves against various predators (Dunne, 2009).

**Conservation**

As we discussed earlier, one of the greatest threats to coral reefs tends to be ocean acidification and rising water temperatures (Dunne, 2009). High temperatures usually make the coral reefs to lose their microscopic algae, which is responsible for producing food. This condition is usually referred to as coral bleaching. Prolonged coral bleaching kills the coral colonies, thus exposing them to threats (Glynn, 2016). Oceans acidification means that the coral reefs cannot be able to build their Calcium carbonate skeleton effectively. Sever acidification breaks the skeletons of the existing coral, which makes a reef to have a structure (Glynn, 2016). Scientists have predicted that by 2085, the conditions of the ocean will be acidic, making some coral reefs to start dissolving.

**References**

Dunne, R. P. (2009). *Synergy or antagonism—interactions between stressors on coral reefs. Coral Reefs,* 29(1), 145–152. doi: 10.1007/s00338-009-0569-6

Fields, H. (2010). *Changing Oceans: Viewing Coral Reefs Through a Cultural Lens. Science*. doi: 10.1126/science.caredit.a1000061

Glynn, P. W. (2016). *History of Eastern Pacific Coral Reef Research. Coral Reefs of the Eastern Tropical Pacific Coral Reefs of the World,* 1–37. doi: 10.1007/978-94-017-7499-4\_1

Stathakopoulos, A., & Riegl, B. M. (2014*). Accretion history of mid-Holocene coral reefs from the southeast Florida continental reef tract, USA. Coral Reefs,* 34(1), 173–187. doi: 10.1007/s00338-014-1233-3

Wells, S. M. (1995). *Science and management of coral reefs: problems and prospects. Coral Reefs*, 14(4), 177–181. doi: 10.1007/bf00334339

Robertson, D. R. (2015*). Coincidental resemblances among coral reef fishes from different oceans. Coral Reefs, 3*4(3), 977–977. doi: 10.1007/s00338-015-1309-8