Warm-water coral reef

DEFINITION

A wave-resistant carbonate structure which is gradually built by stony corals, calcareous algae and other reef-building organisms. Warm-water coral reefs occur in the coastal areas of tropical and subtropical regions.

DESCRIPTION

Corals are composed of many individual coral polyps. A coral polyp is a relatively simple organism, typically composed of a small cylindrical body, topped with a ring of tentacles which are used to capture food from surrounding water. Polyps are animals of the class Anthozoa, which also contains sea anemones and sea pens. Animals in this group are generally sedentary [1]. A large number of corals have evolved to build large colonies based around a communal skeleton. Reef-forming corals (scleractinians) are those that lay down stony skeletons of calcium carbonate for protection and support which can take various structural forms.

GEOGRAPHIC DISTRIBUTION

Warm-water coral reefs are highly restricted in their geographic distribution, needing areas of warm, shallow, clear waters to produce the copious quantities of limestone necessary for reef formation. Warm-water coral reef species diversity is concentrated in the central Indo-Pacific (the “Coral Triangle”), and decreases with increasing distance from the Indo-Australian archipelago[2]. Due to their restricted distribution, coral reefs occupy an area of only 260,000 - 600,000 km^2, less than 0.1% of the Earth’s surface, or 0.2% of the ocean’s surface.[3]

ECOLOGY

Warm-water corals have a symbiotic relationship with algae called zooxanthellae. The algae provide the coral with nutrients derived from photosynthesis, and oxygen. The coral polyp provides the algae with a place to live along with waste products of respiration (carbon dioxide) which are used by the algae in photosynthesis. This symbiotic relationship is why corals live in shallow waters, allowing the algae access to the sunlight in order to photosynthesise.

The zooxanthellae algae provide the coral with colour. When the coral is stressed, it can expel the algae, in a process called ‘coral bleaching’. This leaves the coral looking white because the polyp is mostly transparent and the coral skeleton is white. Coral starves without the zooxanthellae and so, if the stress events continue, it can die. However, if the stress is short-lived the coral can regain their zooxanthellae and survive.[4]

Warm-water coral reefs are the most biodiverse of marine habitats per unit area, with diversity comparable to rainforests but an area only 5% of the size.[5] Most of this diversity is not due to the corals themselves (there being fewer than 1,500 species of stony corals[6]) but rather due to the multitude of organisms that depend on the coral reef ecosystem.[7] Reef species diversity has indeed been estimated at anywhere from 600,000 to more than 9 million species worldwide.[8] In addition, coral reefs are considered to be among the most important ecosystem engineers found in the marine environment.[9] Ecosystem engineers play key roles in ecosystem organisation by providing conditions or resources essential for species to complete their life cycles or by helping to maintain niche diversity such as by providing complex habitat structures.[10] The habitat complexity provided by reefs may be the reason for their high biodiversity and their role as evolutionary engines, acting as ‘cradles’ of speciation. Shallow water coral reefs provide a beneficial environment for evolving new species, which then expand to new environments in the ocean.[11] These key functions of coral reefs make them disproportionately important in comparison to their global footprint.

Coral reefs are the preferred habitat of a number ofCritically Endangered and Endangered species, for example the fish species humphead wrasse (*Cheilinus undulates*) and Banggai cardinal fish (*Pterapogon kauderni*).[12] Some Critically Endangered and Endangered species also depend on coral reef fish as food during key stages of their life cycle, for instance pups and juveniles of the Endangered shark scalloped hammerhead (*Sphyrna lewini*).[12]

ECONOMIC AND SOCIETAL VALUE

Coral reefs provide numerous benefits to those who live locally to them and to the international community. At a local scale, coral reefs provide food and livelihoods. Reef-associated fish are a key source of protein in developing countries. [13] Reefs provide a number of physical functions such as storm protection by attenuating waves (reducing the wave height and energy). As a result, reefs provide support for mangrove and seagrass habitats by reducing the sea's energy levels close to shore. [14]
Two of the most visible benefits of coral reefs are tourism and the inspirational qualities of the habitat. Films, books and posters have all depicted the colourful and energetic reef environment. [14] These visuals have fuelled natural history programmes and provided the general public with insight into this world. As a result, coral reef tourism has grown and provides substantial income in some parts of the world. [15]

THREATS

Reefs are also one of the most endangered habitats on the planet[16], facing dramatic declines in abundance as a result of bleaching and diseases driven by elevated sea surface temperatures, with extinction risk further exacerbated by local-scale human disturbances including coral mining, agricultural and urban runoff, pollution, damaging fisheries and the introduction of damaging invasive species. There is frequently a direct correlation between declining reef health and increasing human population, mainly due to pollution and overexploitation [17]. Destructive fishing practices are a particular problem, with poison such as cyanide being used for live capture of fish for both restaurants and the aquarium trade. Blast fishing is also very destructive, whereby explosives are used to stun schools of reef fish and cause huge damage to the reef, shattering the structure and killing many non-target species [18]. Once the complex reef structure is damaged or destroyed, the niches which provide homes and shelter for the array of species are lost.

INTERNATIONAL THREAT STATUS

The proportion of corals threatened with extinction has increased dramatically in recent decades and exceeds that of most terrestrial groups, with one-third of reef-forming corals facing elevated extinction risk from climate change and local impacts. [19] Specifically, 23 reef-forming coral species are listed as Endangered by the IUCN Red List of Threatened Species, and 6 are listed as Critically Endangered. [12]. Conserving coral reef biodiversity and the capacity of reefs to generate essential services to local people is a global priority [14], and coral reefs are increasingly the focus of biodiversity conservation prioritisation schemes. They are included in the rationale for Key Biodiversity Area (KBA) and marine protected area (MPA) designation, e.g. the Great Barrier Reef Marine Park.

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Polyps of a star coral, Dichocoenia family. A. Gibson/Shutterstock.com

Category:

Marine biodiversity features

Tools

The Ocean Data Viewer A tool for easy access to a range of datasets that are important for the conservation of marine and coastal biodiversity. The data can be downloaded or viewed online.

Coral Reef Watch provides current reef environmental conditions to identify areas at risk for coral bleaching.

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