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Coral Reefs in Alarming Decline due to Climatic Change

Abstract

Coralreefs, with their millions of species,have changed profoundly because of the effects of people, and will continue to do so for the foreseeable future. Reefs are subject to many of the same processes that affect other human-dominated ecosystems, but some special features merit emphasis.

1. Many dominant reef builders spawn eggs and sperm into the water column, where fertilization occurs. They are thus particularly vulnerabletoAlleeeffects, including potential extinction associated with chronicre productive failure.
2. The corals likely to be most resistant to the effects of habitat degradation are small, short-lived ‘‘weedy’’ corals that have limited dispersal capabilities at the larval stage. Habitat degradation, together with habitat fragmentation, will therefore lead to the establishment of genetically isolated clusters of inbreeding corals.
3. Increases in average seatemperaturesbyaslittleas1°C,a likely result of global climate change, can causec oral ‘‘bleaching’’.

Keywords: Coral Reef, Bleaching, Ecosystem, Pollution, Extinction.

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Introduction

The effects of climate change on the biology and ecology of organisms are receiving considerable and increasing attention in the scientific literature. Climatic change has also been implicated in dramatic shifts in species composition and community structure across a number of important and highly sensitive ecosystems (e.g., arctic, arid, tropical rainforests and coralreef ecosystems), as well as contributing to species extinctions within these systems.

Aim of the Study

The world is on the brink of massive extinction event, according to the United Nations. The latest global coral reef assessment estimates that 19 percent of the world’s coral reefs are dead. This research focuses on the majority of threats which include warming sea surface temperature, expanding sea water acidification etc.

“If nothing is done, we could effectively lose coral reefs, as we know them, with major coral extinction”- Clive Willeinsen

Figure 1: Fish Coral Reefs
Image Courtesy: wallpaperbeta.com

Thomas et al. (2004) predict that 15–37% of species in terrestrial ecosystems will be “committed to extinction” given a 2.0°C increase in mean global atmospherictemperatures. Impending species losses will not only alter biological diversity but potentially reduce productivity and ecosystem stability, increasing sensitivity to future disturbances and increasing the livelihood of ecosystem collapse. The devastating effects of recent climate change were first recognisedand are most pronounced on coral reefs, where there are clear links between increasing ocean temperatures and regionalscale bleaching of scleractinian corals.

Coral reefs have existed on the planet for approximately 450 million Years. These are the largest natural structures in the world, and are the result of a remarkable relationship between coral animals and micro scopicalgae. Corals are marine animals belonging to phylum Cnidaria and class Anthozoa.

These organisms, producing hard exo-skeleton of calcium carbonate, are represented by a colony of genetically similar flower like structures called polyps. After many generations the colony secretes a skeleton i.e. characteristics of species. Deposits of these skeletons over long periods give rise to coral reefs. Each polyps is a few millimetres in diameter and has a skeleton cup, a mouth and a stomach.

The ecological balance between corals and their algal partners, and hence the success of corals as reef builders, is potentially very sensitive to environmental conditions. If the zooxanthellae were to disappear, depriving the coral of nutrition, the coral reef will undergo bleaching leaving ghostly white patches as they lose colour and die. Rising water temperatures block the photosynthetic reaction that converts carbon dioxide into sugar. This results in a build-up of products that poison the zooxanthellae. To save itself, the coral spits out the zooxanthellae and some tissue, leaving the coral a bleached white. This phenomenon is called Coral Bleaching.

Figure 2: Sea Coral Reef
Image Courtesy: coris.noaa.go

Importance of the Coral Reef Ecosystems

Biodiversity

Coral reef ecosystem biodiversity is in a constant state of change since various sea creatures such as sponges, bivalves, urchins, and fish live or feed on the different parts of the coral reefs and are all part of one tropic level. When humans consume seafood they are also consuming energy from every organism up the food web from the coral reefs. If corals are damaged by pollution, overfishing, or increased acidification the complex equilibrium of the reef will be permanently altered. Once biodiversity at all levels of the ocean life is lost to human impact, extinction occurs. Extinction is a normal process; however, humans are assisting the process along at a rapid speed. The result is loss of productivity and biodiversity, both of which having a serious economic consequence.

Economic Value

For thousands of years our ocean life has been a part of our lives, from watching the animal life move in the ocean to catching them for profit and food. Coral reefs are a source of medicine by providing new compounds and technology to treat serious diseases. The National Oceanic and Atmospheric Administration says that nearly half of the medicines in use today have their origins in natural products, mostly derived from terrestrial plants, animals, and microorganisms. Creatures found in coral ecosystems are important sources of new medicines being developed to induce and ease labours; treat cancer, arthritis, asthma, ulcers, human bacterial infections, heart disease, viruses, and other diseases, and provides sources of nutritional supplements, enzymes, and cosmetics.

Causes and results of the coral reef damage

Pollution

Pollution impacts all trophic (nutritional) levels of marine life, from primary producers (plants)to top predators (whales), and interferes with the structure of marine communities and the ecosystem functionality Oil tankers leaking oil make up a big part of ocean pollution and can kill or harm the animal life that live within and care for the coral reefs. All of the dead organisms begin to decompose which produce bacteria that use up the oxygen that is needed for the coral reefs to survive.

Changes to Prevent Extinction

The coral reefs are part of the foundation of the ocean food chain and are eaten or inhabited by many sea-going creatures, not to mention provide services with an average annual value estimated at $172 billion to millions of people worldwide that depend on coral reefs for their food and livelihood. Preventing extinction takes investment.

Innovative Solutions

Innovative solutions are currently being proposed to solve the problems caused by oil and gas development activities in the marine environment.Some of the proposed models include marine protected areas in oil sites (MPAOS), ocean fertilization,integrated coastal pollution balancing (ICPB), artificial recruitment in fisheries (ARFS), and artificial reefs from oil rigs (AROR). The main goal of these proposed approaches is to maintain and restore ecological sustainability and ecosystem integrity.

Integrated Coastal Pollution Balancing (ICPB)

The ICPB model will make use of the runoff oil and pollution through the use of balancing ecosystem components by implementing bioremediation, fisheries, food web enhancement, aquacultures, and seaweed plantation which will require an ecological plan to implement. The total number of pollutant inputs can be estimated in a selected area such as runoff oil, agricultural waste or municipal waste release, and other industrial pollution, and an ecosystem model would be developed to use those pollutants.

Artificial Recruitment in Fisheries (ARFS)

The ARFS method compensates fishery production if anything happens as a result of oil and gas development by helping to increase the existing fish stocks and transplant species in targeted areas such as development sites or an alternative site. This allows fishermen to extend their fishing activities into open waters such as lakes, reservoirs, rivers, seas, and oceans. The main objective of the ARFS is to

increase the fish stock of selected species through artificial propagation of seed (fish larvae) in targeted areas and to resuscitate the stocks of over-fished or environmentally altered bodies of water.

Conclusion

Effects of climate-induced coral bleaching are compounding pre-existing pressures from natural and direct anthropogenic stresses (e.g., overfishing, pollution, excess nutrients and disease epidemics) to accelerate and exacerbate widespread degradation of coral-reef ecosystems. To prevent further declines in the condition of coral-reef habitats, and thereby conserve communities of coral-reef fishes, it is imperative to move beyond traditional reductionist management strategies (e.g., marine protected areas) to implement adaptive and targeted management strategies that recognise individual and critical components of habitat structure (e.g., topographic complexity). This requires an entirely different approach to management, requiring bold decisions to prioritise conservation of critical functional attributes rather than focusing on individual stocks or species.

Scientific consensus shows that the coral reefs are on the path to extinction through observation, direct evidence, and collected data; however, time will tell if society can prevent more damage, repair what has already been harmed and become sustainable before the coral reefs disappear forever. On the other hand, the global economy is also a human concern since society relies on the coral reefs for their value in tourism, medicine, and food for human consumption. While both sides have great points, it comes down to extinction.

If we overuse and abuse the coral reefs, they will die. The solution is for a compromise between extinction and valuing the ecosystems using creativity, innovation, and sustainability. Pollution, overfishing and increased oceanic acidification can be slowed down through new and updated policies environmental laws, sustainability, and investing in new innovative solutions.

The extent to which degraded reefs and other habitats can support the associated diversity of healthy coral reef habitats— the current homes for the myriad crustaceans, worms, mollusks, bryozoans, and other groups that are found on reefs—is unknown. Given that reef associates have many times the diversity of the corals them selves, several issues are relevant:

1. Arereefs as ecosystems especially vulnerable to environmental change or slowtorecover?
2. Are reef dwellers less vulner able than corals them selves?

The fossil record of past extinctions provides the only real data for evaluating these questions. It is often stated that reef eco systems are both more vulner able to extinction and slower to recover, but rigorous analyses are surprisingly limited. Past extinction events appear to have had a diverse suite of causes, not surprisingly, because global change in any direction from the status quois likely to accelerate extinction; this probably explains why there is no strong bias against tropicaleco systems over all.

It is hoped appreciation of the likely impacts of climate change on coral-reef fishes will fuel international efforts to take action on climate change, while bold management initiatives are needed to maximise capabilities of coral reef ecosystems.

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