Small Island Ecosystems: A Precarious Balance

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Introduction

Human beings have long depended on the biotic and abiotic resources of the Earth not only for food and subsistence but also for social and economic development. Where once we were a part of natural ecosystems and of Earth's great biodiversity, we are now a threat to it. Our ever-growing wants and needs, essentials and economies, are having a great toll on this planet's natural ecosystems resulting in increasing degradation, habitat loss, biodiversity declines and worldwide extinctions. Nowhere are these impacts felt more than in small island ecosystems; as the smallest contributors to the problem and yet the greatest victims of the effects these distant isles deserve a closer look.

In India we have two such tropical small island systems : The Lakshadweep Islands off the West Coast of India in the Arabian Sea and the Andaman & Nicobar Islands far out on the East Coast in the Bay of Bengal. While the topography, the geological age and the terrestrial flora and fauna differ quite dramatically; they share in common the fact that both contain coral reefs and associated ecosystems. Both island groups are home therefore to an astounding amount of biodiversity and achieve it despite being surrounded by an ocean of very low nutrient waters.

Coral reefs are an integral part of small island ecosystems in the tropics. Coral reefs are formed by calcifying organisms that survive in low nutrient waters via a symbiosis of polyps and zooxanthellae algae. Over thousands of years, they build reefs that grow at a rate of only a few centimeters a year, but provide structure & habitat, food & nutrition to scores of species. Of the 34 recognized animal Phyla, 32 are found on coral reefs. Apart from the many invertebrates (lobsters, crabs, worms) and megafauna (sharks, rays, turtles), coral reefs

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Figure 1: Lakshadweep Islands, India

Figure 2: A coral reef in the Andaman & Nicobar Islands, India

support more than 800 hard coral species and more than 4000 species of fish. Despite covering less than 0.2% of the ocean floor, over 25% of the species found in the ocean are associated with coral reefs.

Apart from the intrinsic value of biodiversity, these reefs also provide essential services to small islands. In certain areas (*e.g.* the Lakshadweep Archipelago), where there is low soil productivity, they provide the most important source of food to the people living on those islands. Often, such as is the case with the Andamans & Lakshadweep, they are also economically important to the locals via commercial fisheries and tourism. Small islands are particularly susceptible to hurricanes, storm surges and tsunamis. Coral reefs are also important physical barriers against such extreme weather events, and protect the erosion of land into sea. In Lakshadweep, where the average altitude is only 4 metres above sea level, this protection is vital in the current scenario of global warming, weather disruptions and sea level rise.

Having evolved into these robust systems over millions of years, anthropogenic influences over the past 50 years have now rendered coral reef ecosystems in grave trouble. 20% of the world's coral reefs are dead and lost, and another 20% are severely degraded. The reason for this is that coral reefs require a certain balance - a limited temperature range, a narrow pH band, clear and nutrient-free waters - to survive. While they have shown great resilience in the past, they require a robust and otherwise undisrupted system to deal with short term fluctuations in weather conditions.

Coral reefs, their inhabitants and tropical small islands are therefore in danger of becoming the first large–scale victims to the unabated rise in carbon dioxide emissions. Increased fossil fuel burning has led to two problems - rising temperatures and an alteration in seawater chemistry. Warmer sea surface temperatures disrupt the essential relationship between coral polyps and their nutrition-giving symbionts - zooxanthellae. It leads the polyps to expel the zooxanthellae from their tissue, causing coral bleaching and eventual death if the temperature fails to drop. Ocean acidification is also known as 'The Other CO_2 problem'. When excess carbon dioxide dissolves into the ocean it results in a

Figure 3: Mangrove forest in the Andaman & Nicobar Islands, India

series of chemical reactions that lead to a drop in the pH level in the ocean. The altered chemistry has ramifications on marine life -calcifying organisms such as corals are adversely affected in both the calcification process essential for reef building and the weakening of existing calcium carbonate structures.

So do these global trends spell the end for coral reefs? Not necessarily. While the world needs to work together to reduce fossil fuel emissions in the long run, there are steps that can be taken at the national and state level to reduce local impacts on reefs. Controlling local variables leads to increased resilience and resistance in reef ecosystems. An important part of this is to protect the forests and mangroves on the isalnds - this is especially the case in the Andaman & Nicobar Islands which are rich in terrestrial flora. The forests and mangroves act as a filter, reducing the silt and mud that flows into the ocean and increase its turbidity. Greater clarity in the seawater is important for corals that can otherwise get smothered with silt. Mangroves worldwide have dropped from 30% to 50% of their historical cover - this trend must be halted in our island ecosystems by providing local people an alternative means of cooking fuel and by having strict laws in place to prevent mangrove clearing for commercial purposes.

Another important local factor that must be addressed is nutrient flow and pollution into our ocean, by creating sewage treatment plants in every city and island, by having better solid waste management programs and by reducing agricultural fertilizer run-off into our water-bodies.

Overfishing is a problem worldwide, but one that can be controlled at the local level. Both groups of islands - Lakshadweep & ANI - are subject to severe fishing pressures domestically as well as by international poachers. Both have seen a severe decline in large fish stocks, shark populations and turtles. It is a wonder of nature, that not only do coral reefs provide support to fish populations, the fish and megafauna are also essential to reefs! Many studies are showing that the removal of predators (such as sharks and groupers) from an ecosystem reduces its overall resilience. Today, seeing

a shark in Andaman waters is a rare occurrence - thanks to India's infamy of being the second largest elasmobranch exporter in the world. It is essential to not only declare Marine Protected Areas, but also to truly enforce that protection and stop destructive fishing practices such as dynamite fishing, poison fishing and bottom trawling.

Island ecosystems are important not only because of their beauty and biodiversity, but also because they host a very high degree of species endemism and are a unique natural ecosystem of India. They support not only rare marine animals, but also a rare and different human society - the tribes of the Andaman & Nicobar, the artisanal fisher community of the Lakshadweep and

Figure 4: White-tip reef sharks in Lakshadweep Islands, India

Figure 5: Live Coral Garden

many others. As a society with a rich cultural heritage, we must ensure that our rapid development doesn't lead to the obliteration of that same cultural diversity.

The Earth is a network of interdependent ecosystems, of which humans are a part and equally reliant. For the protection of the highest Himalayan peaks, our deepest forests to our most distant aquamarine isles, the method is the same: use more renewable energy sources, cut less trees, recycle plastics, reduce pollution in the form of industrial wastes, sewage and solid waste impacts. India is in a rare position to make a true difference - with our wide range of natural ecosystems we have a lot to lose, with our great population we are able to make a significant impact and with our position of regional political leadership we can pave the way for the entire continent. We hope we will come together and act, before we lose our most fragile and unique small island ecosystems.