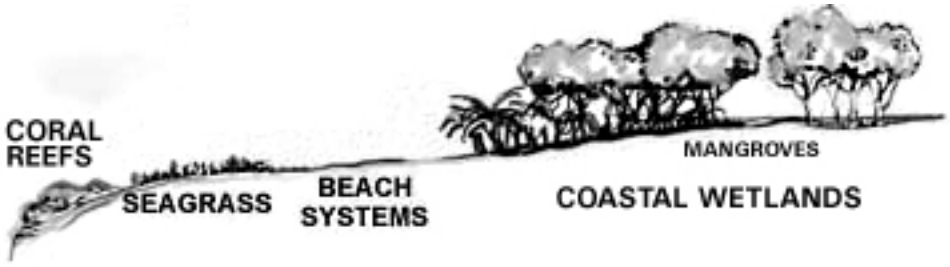
COASTAL AND MARINE ECOSYSTEM BASICS AND VALUES
The Coastal Zone

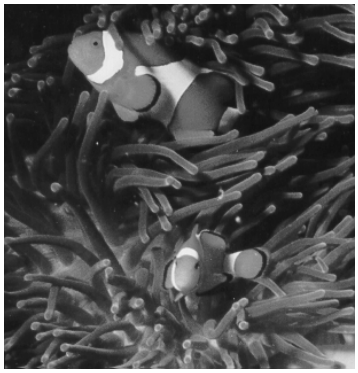
The coastal zone is defined as "the strip of land and adjacent lake or ocean (water and submerged land) in which the land ecology and land use affect lake and ocean space ecology and vice versa. Functionally, it is a broad interface between land and water where production, consumption and exchange processes occur at high rates of intensity. Ecologically, it is an area of dynamic biochemical activity but with limited capacity for supporting various forms of human use. Geographically, the outermost boundary is defined as the extent to which land-based activities have measurable influence on the chemistry of the water or on the ecology or biota. The innermost boundary is one kilometer from the shoreline except at places where recognizable indicators for marine influences exist, like mangroves, nipa swamp, beach vegetation, sand dunes, salt beds, marshlands, bayous, recent marine deposits, beach and sand deposits, and deltaic deposits in which case the one-kilometer distance shall be reckoned from the edges of such features." *(National Environmental Protection Council, 1980)*

The Philippine coastal zone is typical of tropical coasts, with at least four major resource units occurring along its shallow coastlines: coral reefs, beach systems and coastal wetlands (including mangroves).



Coral reefs. Coral reefs occur along shallow, tropical coastlines where the marine waters are oxygenated, clear and warm, and free from suspended sediments, excessive freshwater runoff, and pollutants. The actual reef consists of large and rigid structural mass of calcium carbonate formed by the cemented skeletal remains resulting from the successive growth and development of reef-building corals. Although corals are colonies of small animals, each living unit contains algal populations within its own tissues which are capable of photosynthesis, thus providing an energy source for both the coral and the algae. The corals themselves are relatively slow-growing colonies of animals with growth rates ranging between 0.1 cm and 10 cm per year in length.

Coral reefs are considered as the "rainforests of the sea" and one of the most complex and diverse ecosystems in the world. The large and diverse animal populations associated with the reef – nearly a million species in all — are supported both by the net primary production occurring on the reef and by the organic materials that are continually brought to the reef by marine currents. Up to 3,000 species of marine animals may co-exist in a single reef, where the density of fishes can be 100 times greater than the ocean average. Reefs can grow to tens of meters high and as long as 2,000 kms.

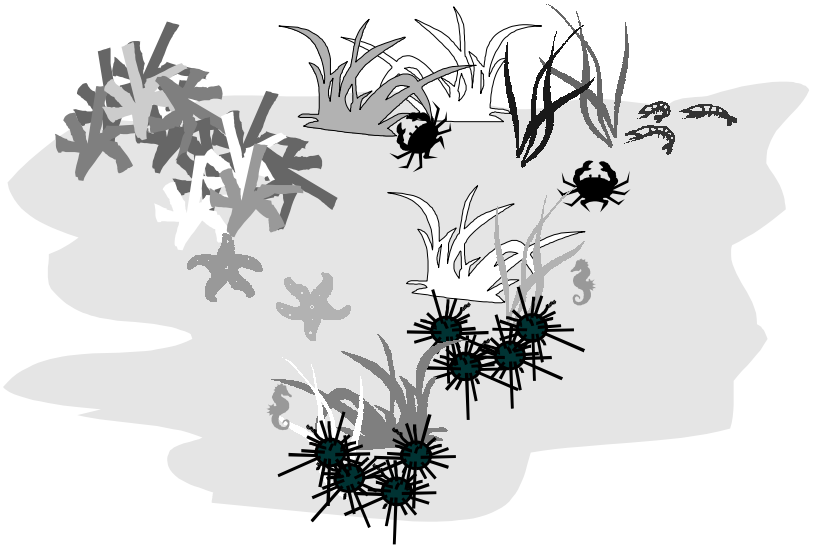


Coral reefs are found in more than 100 countries of the tropics. For thousands of years, coastal communities have relied on reefs for a host of products. Today, people continue to depend on reefs for an essential protein source, fish for a variety of products and services, including food, building materials, recreation, and shoreline protection against storms.

The Philippines lies in the Indo-West Pacific Region, reputedly the world's highest biodiversity marine area, and is part of what is known as the "coral triangle," the center of the most diverse habitat in the marine tropics. The country's coral reefs host about 400 species of corals, 971 species of benthic algae, and a third of the 2,300 fish species known to inhabit Philippine waters. There are 27,000 sq km of coral reef areas in the Philippines, with 60% of them occurring in Palawan.

Seagrasses. Seagrasses are seed-producing marine plants that occur in shallow, nearshore waters, the only group of submerged flowering plants in tropical and marine environments. They grow in the intertidal region to depths of 30 meters, and are most conspicuous in the shallow subtidal area. Largely taken for granted, they perform many important functions. They stabilize and hold bottom sediment even under the force of hurricanes and storms. They provide shelter and refuge for adult and young marine animals, many of which are commercially important. They provide food for fish, sea turtles and other marine animals, including the endangered Dugong and the Green sea turtle. They trap debris and small particles and produce dissolved organic matter, thus contributing to nutrients cycle within the ecosystem. They also serve as a nursery ground for many fish species.

The Philippines has 16 known species of seagrasses, the highest number in the Indo-Pacific region. These species are valued mainly for their role as fish nursery areas and as foraging grounds for food fish, Dugong, turtles and wading birds. The depletion of seagrass beds is known to result in high water turbidity and lower production of seagrasses and their associated fauna. Sadly, seagrass ecosystems in the Philippines are under threat from various natural and man-made forces – typhoons, tidal waves and volcanic activity as well as mining, aquaculture, deforestation and blast fishing.



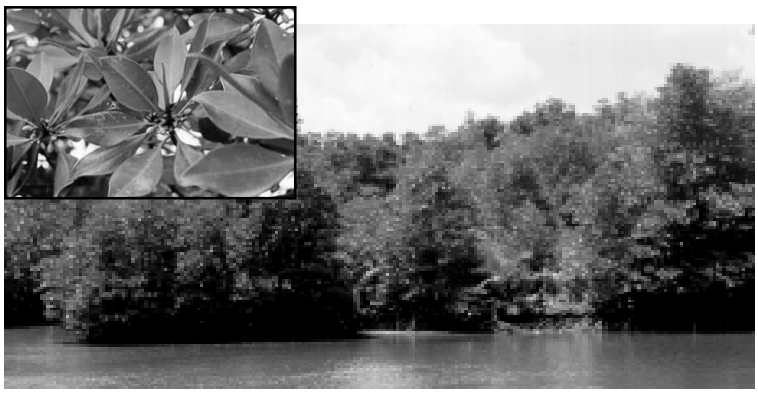
Beach systems. Beaches consist of accumulated, unconsolidated sediments transported to shore and molded into characteristic forms by wave-generated water motion. Beaches are located between the lowest seaward tide level and the inland limit of the average highest storm waves, exclusive of catastrophic storm events. Changes on a beach are responses to processes acting far outside the limits of the beach itself, however. Beaches are dynamic, not stable, land forms, constantly subjected to forces that promote erosion and/or accretion. Differences in beach form (or type) and position reflect the local balance or imbalance between deposition (or accretion) and erosion (or loss). Worldwide, there is general belief that erosional forces, both natural and man-induced, tend to dominate the accretional forces. This is indicated by a loss of beaches and beachfront in many parts of the world.

Most small Philippine islands have coral sand beaches, i.e., beaches formed by coral reef growth and erosion. Forming an integral part of the reef communities, these beaches depend on healthy coral reefs for continued supplies of sand, at the same time supporting crustaceans, mollusks and some worms. Undisturbed beaches also serve as nesting places for turtles. Unregulated and unplanned development of beaches for tourism, construction of sea walls, jetties and harbors, and the quarrying of sand for construction and other purposes are some of the most common threats to beaches in the Philippines.

Coastal wetlands. This covers mangroves and their associates, such as *Nypa fruticans* (nipa palm), and rivers.

Mangroves. Mangroves are salt-tolerant, woody, seed-bearing plants. They range in size from tall trees to small shrubs; worldwide, there are more than 50 species, more than 35 of which occur in the Philippines, where they cover about 138,000 hectares. They are characterized by their common ability to thrive along sheltered, inter-tidal coastlines on sediments that are saline, often low in oxygen, and sometimes acidic. This ecosystem is economically and socially significant for its role in the existence and perpetuation of nearshore fisheries, the protection of coastlines, as a renewable resource, and as a location for permanent and temporary human settlements. Mangroves form an important link between the shore and coastal ecosystems. They can form dense forests along coastlines and rivers and act as effective traps of sediment, nutrients and pollutants. They control freshwater surface flow, stabilize coastal areas, export detritus and act as refuges for fish fry.

Mangroves have been used for centuries by Filipinos for food, forage for animals, building materials, fuel, folk medicine and various other purposes. In fact, the Philippine capital Manila was originally called *Maynilad* ('there is *nilad*') after a mangrove species known locally as *nilad* and found extensively in the old days in the Pasig River Delta.



(Some parts of this section were adapted from Coasts. Coastal Publication No. 2, Renewable Resources Information Series. S.C. Snedaker, C.G. Getter,Research Planning Institute Inc. in cooperation with National Park Service-United States Department of Interior and United States Agency for International Development)

COASTAL AND MARINE ECOSYSTEM BASICS AND VALUES
Resource Values

The benefits that can be derived from coastal resources are well-known and widely recognized. These benefits, expressed in economic terms, are described below:

Coral reefs. Coral reefs are the coastal ecosystem which provides the most substantial and sustainable source of sustenance to people in the Philippines. The 18,000-km coastline of the country is estimated to have about 27,000 sq km of coral reef fringing its shores or in offshore areas in the form of submerged reefs or coral atolls. This area is equal to slightly more than 10% of the total land area of the country.

It is estimated that more than one million small-scale fishers depend directly on reef fisheries for livelihood. In addition, reef fisheries supply a sizable amount of protein in a country where more than 50% of the animal protein is derived from marine fisheries and aquaculture.

The contribution of reef fish to the total fisheries of the Philippines ranges from 8% to 20% (or about 143,200-358,000 tons). The contribution of reef fishery to some small island fisheries in the Philippines is as much as 70% of the total fish harvest. The average documented reef yields for the Philippines is 15.6 tons per sq km per year. When we destroy reefs, we destroy income for various beneficiaries in the order of US$50,000 (Php1.9 million at Php38:US$1) per sq km per year of healthy coral reef. With 27,000 sq km of coral reef, if 50% of this is in a condition which will support estimated revenues at an average level, coral reefs can contribute almost US$1 billion (Php38 billion) annually to the Philippine economy.

Mangroves. Mangrove ecosystems have extremely high natural productivity in terms of plant growth and all the associated organisms. Much of this productivity translates into useful products for people in the form of wood, fish and crustaceans and various other ecological and economic benefits. Direct economic values estimated in the Philippines for mangrove wood and fish products combined range from US$153 to US$1,396 (Php5,814 to Php53,048) per hectare per year. The lower estimate is based on the Pagbilao (Quezon Province) mangrove forest for which direct observation of occurring species (for both fish and forest) was made in a relatively degraded mangrove area. The higher estimates, which do not include revenues generated from aquaculture, are consistent with a study that estimates the value of a complete mangrove ecosystem to be in the range of US$500 to US$1,550 (Php19,000 to Php58,900) per hectare per year. Based on these estimates, the average annual conservative return used for Philippine healthy mangrove forests and habitats is US$600 (Php22,800) per hectare per year. A simple calculation for all the abandoned fishponds in the country, which were once thriving mangroves, will tell us that we can afford to replant mangroves and to maintain their continuous benefits.

Fisheries. The Philippine population is highly dependent on fish food. Recorded per capita consumption of the "fish, meat and poultry food group" is 54 kg per year in 1993, of which 67% is composed of fish and fish products. The food group that includes fish is thus the second most important component of the Filipino diet next to rice.

On a national scale, fisheries contributed 3.5% to the gross domestic product (GDP) and 16% of gross value added (GVA) in the agricultural, fishery and forestry sectors in 1996, both at current prices. In the same year, exports of fishery products amounted to Php 15 billion with the top commodity exports being tuna, shrimp and seaweed, in descending order of importance.

The fishing industry also provides employment to about one million people, roughly 5% of the country's labor force. Of this, 60% is accounted for by the municipal fishing sector, 28% by aquaculture, and the rest by commercial fishing.

The nearshore area is the most biologically productive area for fisheries, and also the most overexploited. In 1996, the total catch of the municipal sector reached 700,000 tons valued at Php25.4 million, including the value of inland catch. Municipal catch, however, is often underestimated because the number of small-scale fishers who consume or sell the fish is not recorded.

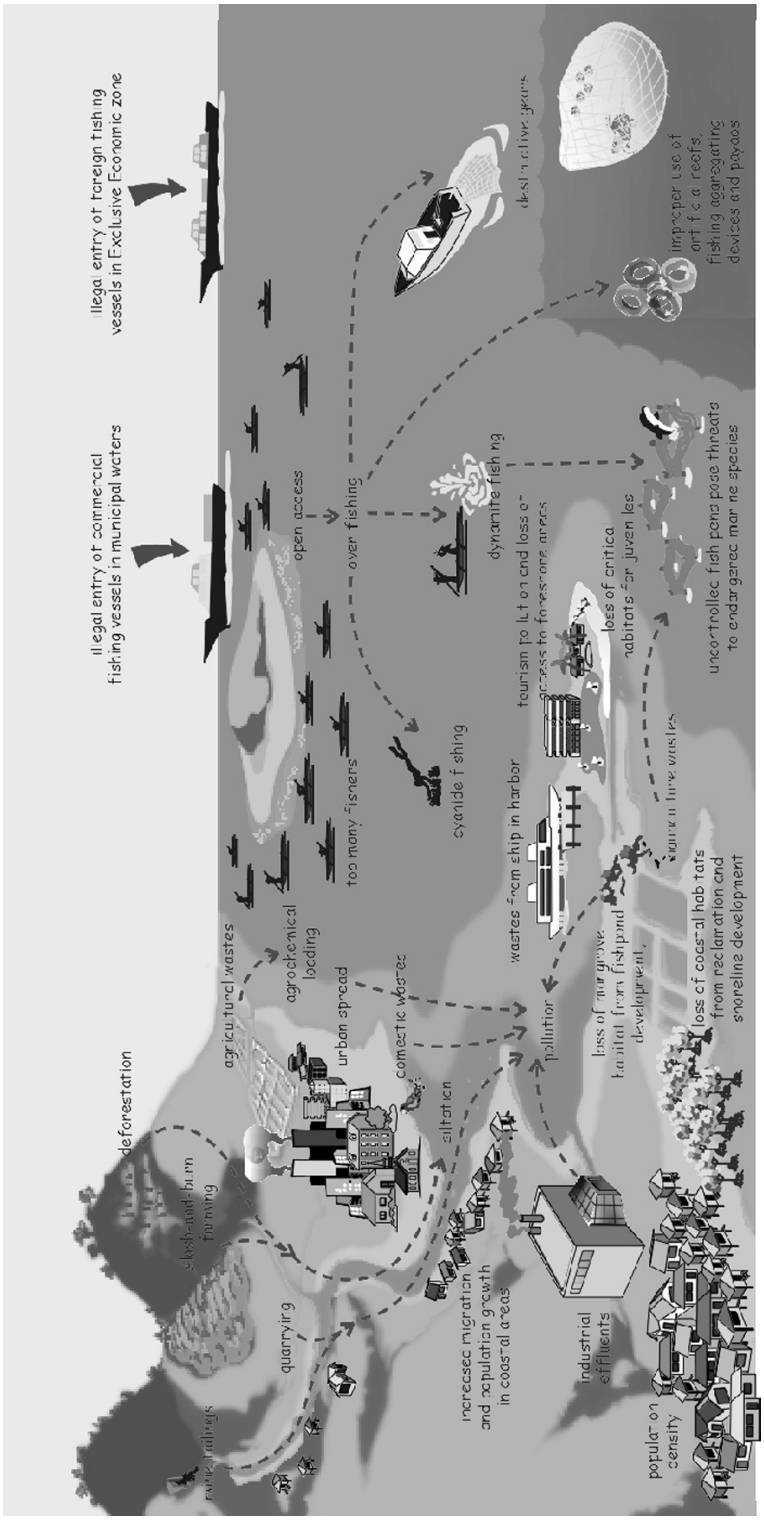
The sad story is that fisheries are beginning to decline. There is clear evidence that overfishing or too much effort per unit area and catch is occurring in all the important fisheries of the country. The consequences are that the overall catch is decreasing and catch per unit effort is decreasing and that profits to all concerned are declining. The loss in economic rent is about US$0.5 billion (Php19 billion) annually for small pelagic fisheries alone.

Water quality. There is one crucial link binding all coastal resources together and affecting their conditions and economic usefulness to humans. This, of course, is *water.* Water and its transport role are crucial in the maintenance of all coastal ecosystems because these ecosystems and their numerous organisms are dependent on the incubation and movement of larvae which provide new recruits of fish, invertebrates and plants to all coastal systems. Water quality directly affects the viability of these minute living organisms to survive and be successfully transported to their eventual home where they reproduce.

Most kinds of pollution are carried by water and affect all living coastal resources and their ability to grow and reproduce naturally. As the sea becomes more polluted, we will lose living coastal resources at an increasing cost to society. For example, if a coral reef is destroyed from urban runoff or fresh water flooding, the losses could be equal to the original productivity of that reef plus whatever other benefits derived from it, such as coastal protection. This can amount to Php1.9 million per sq km per year from fishing and tourism. Or, looking at polluters' willingness-to-pay for losing their ability to dump into the ocean or a river for free, the cost of pollution for Lingayen Gulf would be approximately Php366 million annually. This amount is probably a conservative estimate of what is actually lost in terms of decreased fish catch and lowered tourism appeal in the Gulf.

(Adapted from The Values of Philippine Coastal Resources: Why Protection and Management are Critical. A.T. White and A. Cruz-Trinidad. CRMP/DENR/USAID. 1998.)

STATUS ALERT
Human Impacts on Coastal Resources and Ecosystems

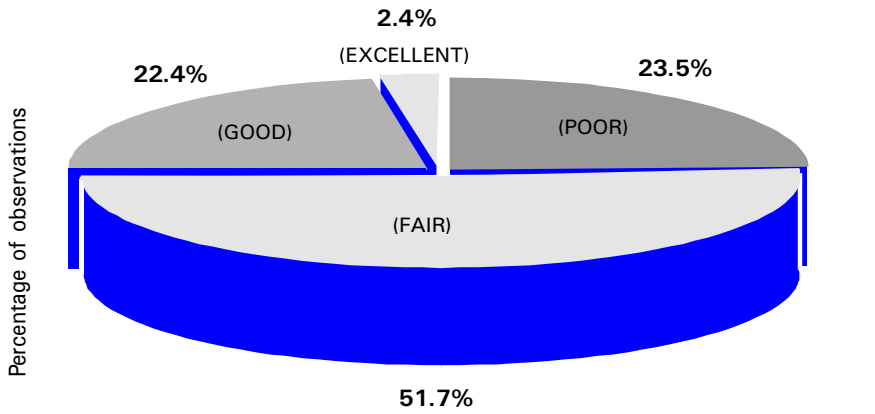


"The coasts are the natural crossroads between human activity and the sea." – *Weber 1993*

As an archipelagic nation, the Philippines is essentially one big coastal zone. Impacts on coastal resources may be felt from activities conducted from the highest mountain peak to the coastal and marine waters. Human impacts on coastal resources in the Philippines continue to intensify as increased population pressure on land and in the sea are resulting in the degradation of fisheries, coral reefs, and mangrove areas that serve as the basis for food security, economic development and biodiversity conservation.

STATUS ALERT
Coral Reefs

The overall condition of the coral reefs in the Philippines is grim. Most reef areas have been adversely affected by human activities, and less than 5% are considered to be in excellent condition. Siltation from deforested uplands, destructive fishing practices, pollution, and physical removal are the major factors causing their degradation. Fishing techniques that damage coral reef habitats, especially the use of dynamite, cyanide and fine mesh nets which remove small fish and inhibit successful reproduction, have short-term benefits and huge long-term costs. Reefs that are damaged or destroyed can take 50 years or more to recover. When reefs are destroyed, the fish catch declines accordingly. One square kilometer of "good" reef can produce about 20 tons of fish per year for harvest; in contrast, a square kilometer of reef in poor condition produces less than 5 tons of fish per year.



Status of Philippine coral reefs in 14 localities (about 75% of the reefs are in poor and fair categories).

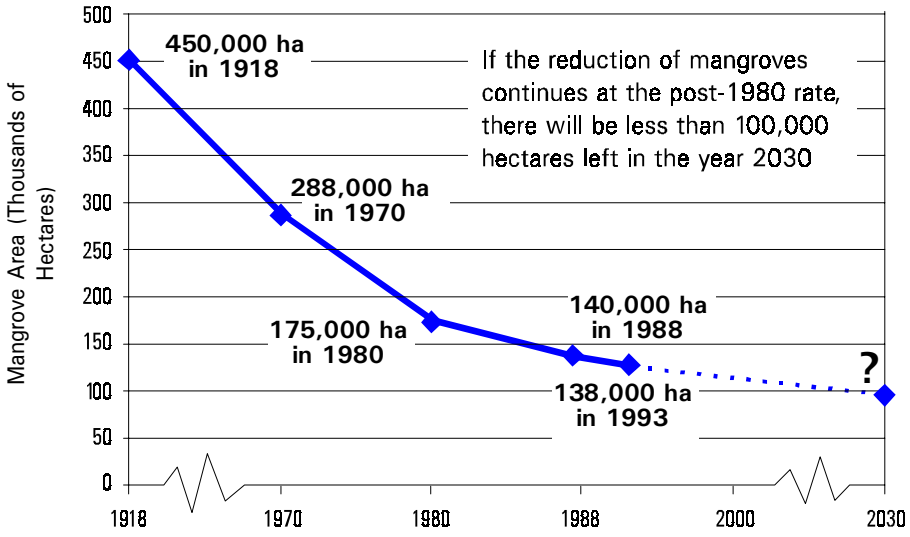
Source: A review of the status of Philippine reefs by Gomez, E.D. et. al. Marine Pollution Bulletin 29 (1-3): 62-68

For immediate action:

- Establish marine sanctuaries to protect and rehabilitate critical coral reef areas
- Monitor and stop all shoreline development activities that threaten coral reefs through physical removal, siltation and other impacts

STATUS ALERT
Mangroves

The area of mangrove forests in the Philippines has declined significantly from an estimated 450,000 hectares at the beginning of the century to approximately 138,000 hectares in the mid-1990s. Major losses of mangrove areas occurred in the 1970s and 1980s, when the Philippine government, in an effort to boost fish production from aquaculture, encouraged the conversion of mangrove forests to shrimp and fish ponds. Unfortunately, the mangroves were converted to aquaculture without any analysis of the appropriate rent for such areas or the potential losses that might occur as a result of their destruction. Thus, when many fishponds were abandoned in the late 1980s because of disease outbreaks and declining economic returns, the country found itself losing not only the production of the fish ponds, but also natural fishery production from clear-cut mangrove areas.



Mangrove Resource Decline in the Philippines

Sources: ADB (Asian Development Bank). 1993. Fisheries sector profile in the Philippines. ADB, Manila.
DENR (Department of Environment and Natural Resources). 1988. Mapping of the natural conditions of the Philippines, Final Report. Swedish Sapce Corporation, Solna, Sweden.
World Bank. 1989. Philippines: environment and natural resources management study, The World Bank.

It is now well accepted that mangrove forests can support more than 600 kg per hectare per year of natural fish production in the nearshore waters. Even so, a new upsurge in the development of illegal fishponds threatens the remaining mangrove areas. In addition, increased population pressure in coastal areas is resulting in the destruction of mangrove forests from all types of uncontrolled shoreline development, including land reclamation and illegal construction of houses and other structures such as ports and harbors.

For immediate action:

- Monitor and stop all shoreline development activities that threaten mangrove forests or convert them to other uses
- Protect all existing mangrove forest areas before they are damaged or destroyed