

# CORAL REEFS – ECOSYSTEMS AT RISK

## A. CORAL REEFS ARE VALUABLE ECOSYSTEMS

Coral reefs and their associated sea grass and mangrove habitats are among the most diverse and valuable ecosystems on Earth. These reef systems are storehouses of immense biological wealth and provide economic and environmental services to millions of people as shoreline protection, areas of natural beauty, recreation and tourism, and sources of food, pharmaceuticals, jobs, and revenues. According to one estimate, these *rainforests of the sea* may provide good and services valued at \$375 billion each year – an amazing figure for an ecosystem that covers less than one percent of the Earth’s surface (Costanza et al., 1997).

The U.S. has significant interests in protecting our Nation’s coral reef ecosystems. U.S. coral reefs cover approximately 17,000 square kilometers of the U.S. Exclusive Economic Zone (EEZ). Current estimates suggest that approximately ninety percent of U.S. reefs are located in the Western Pacific (i.e. Hawaii, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands); the remainder is located near Florida, Texas, Puerto Rico and the U.S. Virgin Islands. In addition, reef habitats play a central cultural role in many U.S. islands, where community-based management, subsistence fisheries, and protected areas have historically been part of local culture and practice.

The U.S. also has interests in helping to protect coral reef ecosystems internationally. Healthy marine ecosystems are critical to U.S. efforts to promote economic and food security, social stability, democratic governance, improved human health, disaster and climate change mitigation, and biodiversity conservation in many countries. Coral reef ecosystems have great economic, social and cultural importance to many Nations and entire regions (Best et al 2002; Cesar 2000). These valuable ecosystems constitute the economic and biological foundation for sustainable development in many countries, particularly small island nations.

In addition, the health and value of many U.S. coral reefs depends on the condition of reef ecosystems in other countries. For example, juvenile corals, fish, and other reef species are carried by currents from the broader Caribbean and Central America to U.S. coral reefs in Puerto Rico, the U.S. Virgin Islands and Florida. This “seeding” of U.S. reefs from non-U.S. is important to sustaining healthy U.S. reef systems. These currents can also carry potentially harmful pollutants and diseases, further emphasizing the need for sound ocean and coastal management internationally. Similarly, the coral reefs of many of the U.S. Pacific territories are

connected to those of other Indo-Pacific reefs. Conserving coral reefs is a challenge of global dimensions.

Coral reefs provide a vast array of valuable services to the Nation and the world (Cesar 2000). For example:

- TOURISM** -- The tourism industry is one of the fastest growing sectors of the global economy. U.S. coral reefs are a major destination for snorkelers, scuba divers, recreational fishers, boaters and sun seekers. Diving tours, fishing trips, hotels, restaurants, and other businesses based near reef systems provide millions of jobs and contribute billions of dollars in tourism-dependent revenue annually in many U.S. regions. Recent studies show that millions of people visit coral reefs in the Florida Keys every year, and these reefs support significant economic activity through sales, income and employment. For example, over 3.6 million people participated in a reef-related activity in the Florida Keys coral reefs of Monroe County in 2001. These reefs supported \$363 million in sales, \$106 million in income, 8,000 jobs and an asset value of \$1.8 billion. Overall for southeast Florida's coral reefs, 18 million people participated in reef related activities during 2001, and these reefs are estimated to have an asset value of \$7.6 billion (Johns et al., 2001).
- **FISHING** – Approximately 50 percent of all federally managed fisheries species depend on coral reefs for part of their life cycle (*TASK FORCE Coastal Uses Working Group Summary Report*, 1999). The annual dockside value of commercial U.S. fisheries from coral reefs is over \$100 million (NOAA/National Marine Fisheries Service). The annual value of reef-dependent recreational fisheries probably exceeds \$100 million per year. In developing countries, coral reefs contribute about one-quarter of the total fish catch, providing critical food resources for tens of millions of people (Cesar 2000).
  - **COASTAL PROTECTION** -- Coral reefs buffer adjacent shorelines from wave action and prevent erosion, property damage and loss of life. Reefs also protect the highly productive mangrove fisheries and wetlands along the coast, as well as ports and harbors and the economies they support. Globally, half a billion people are estimated to live within 100 kilometers of a coral reef and benefit from its production and protection.
  - **BIODIVERSITY** -- Reefs support more species per unit area than any other marine ecosystem, including about 4,000 documented species of fish, 800 species of hard corals and hundreds of other species. Scientists estimate that there may be another 1 to 8 million undiscovered coral reef species (Reaka-Kudla 1997). In many ways, coral reefs rival and surpass tropical rainforests in their biological diversity and complexity. This biodiversity may be a source of natural products derived from reef dwelling organisms. Many pharmaceuticals are now under development from coral reef animals and plants as possible cures for cancer, arthritis, human bacterial infections,

viruses, and other diseases. Coral reef ecosystems are considered to be a key source of natural compounds for new medicines for the 21<sup>st</sup> century.

- **NATURAL HERITAGE** -- Coral reefs are an important part of our natural heritage, rivaling the longevity and complexity of some treasured land-based ecosystems like old growth forests, Joshua trees, Sequoia trees, Saguaro cacti, and other ancient features. For example, a well-developed reef may be the manifestation of thousands of years of incremental accretion by its resident coral colonies, sometimes growing outwards only millimeters each year. Many coral species have no known limit on colony size or age and can thus continue growing indefinitely in favorable habitats. As a result, some of the largest individual coral colonies found on U.S. reefs today were almost surely alive centuries ago, long before modern uses and pressures developed. The scientific, aesthetic and conservation values of such ancient animals and their complex biogenic habitats are unparalleled in the world's oceans, and indeed on land as well. These are truly living museums of the world's marine biological diversity.

## **B. MAJOR THREATS TO CORAL REEF ECOSYSTEMS**

The value of coral reefs to the Nation is matched only by their vulnerability to harmful environmental changes, particularly those resulting from human activities. In 2000, the Global Coral Reef Monitoring Network estimated that 27 percent of all coral reefs were effectively lost; a total of 40 percent of the world's coral reefs may be lost by 2010, particularly those near human populations; and, if current pressures continue unabated, 58 percent may be lost completely by 2030 unless urgent management action is taken to reduce human impacts on reef ecosystems (Wilkinson 2000).

Over the past decade, many expert groups have documented and evaluated the growing number of anthropogenic threats to coral reefs, and possible management solutions to reduce these threats (Bryant 1998; Wilkenson 2000; Burke 2002; Best et al. 2002; Schuttenberg 2001; Turgeon et al 2002). The U.S. Coral Reef Task Force identified 7 specific and widely accepted threats as being particularly important, and tractable, for immediate action by its member agencies and non-governmental partners:

- **POLLUTION**, including eutrophication and sedimentation from poor or overly intensive land use, chemical loading, oil and chemical spills, marine debris and invasive alien species.
- **OVER-FISHING AND OVER-EXPLOITATION** of coral reef species for recreational and commercial purposes, and the collateral damage and degradation to habitats and ecosystems from fishing activities.
- **HABITAT-DESTRUCTION AND HARMFUL FISHING PRACTICES**, including those fishing techniques that have negative impacts on coral reefs and associated habitats. This can include legal

techniques such as traps and trawls used inappropriately, as well as illegal activities such as cyanide and dynamite fishing.

- **DREDGING AND SHORELINE MODIFICATION** in connection with coastal navigation or development.
- **VESSEL GROUNDINGS AND ANCHORING** that directly destroy corals and reef framework.
- **DISEASE OUTBREAKS** that are increasing in frequency and geographic range are affecting a greater diversity of coral reef species.
- **GLOBAL CLIMATE CHANGE** and associated impacts including reduced rates of coral calcification, increased coral bleaching and mortality (associated with variety of stresses including increased sea surface temperatures), increased storm frequency, and sea level rise.

### **C. RANKING OF MAJOR THREATS TO CORAL REEF ECOSYSTEMS BY REGION**

In developing this strategy, NOAA worked closely with representatives from the U.S. Coral Reef Task Force, regional managers, scientists and others to identify the major threats or causes of reef decline and loss in each region as a first step in understanding the key problems to be addressed in each area. The results of this assessment are shown in Table 1.

Table 1 provides a general summary of the relative impact (H = high, M = medium, L = low) of natural and human-related threats to U.S. and international coral reefs in each region. The rankings were provided by regional scientists and managers, and representatives to the U.S. Coral Reef Task Force, for use in this report and the first biennial report on the status of U.S. coral reef ecosystems (Turgeon et al 2002).

Please refer to the Table for specific rankings of threats in each region or jurisdiction. In general, the Table illustrates that:

- The relative impact of different threats varied by jurisdiction and region.
- Some jurisdictions had a few high impact threats; most indicated 6-7 of the 13 threats having high impact.
- Some threats are consistently ranked as having high to medium impact on reefs across most regions (e.g., coastal development and run-off; coastal pollution; fishing; ships, boats and groundings).

- Some threats are of high concern in some regions but not others (e.g., diseases are high concern in the Atlantic/Caribbean, but low concern in the Pacific).
- Some threats were ranking as currently having relatively low impact (e.g., offshore oil and gas exploration).

Although the actual impacts of each threat will vary within and between regions depending on conditions, location and other factors, this information is critical to developing effective local, regional and national efforts to address threats to coral reef ecosystems.