

**CHAPTER 21:****PRESERVING CORAL REEFS AND OTHER CORAL COMMUNITIES**

*Coral reefs and other coral communities are beautiful and diverse, as well as biologically and economically valuable. In addition to well-known tropical coral reefs, coral communities can also be found in deep waters and at high latitudes. Increasingly, coral reefs and other coral communities are facing threats from a number of natural and human-induced causes. To conserve these unique ecosystems, comprehensive coral reef protection and management legislation is needed to address research, protection, and restoration of coral ecosystems. A strengthened U.S. Coral Reef Task Force should lead and coordinate federal coral management efforts. The United States must continue to be a leader in coral management at the international level, including promoting the development of international standards for sustainable harvesting of coral reef resources. Finally, improved research and data collection are critical to better understand coral ecosystems and the impacts of human activities on them.*

**ASSESSING THE STATUS OF CORAL ECOSYSTEMS**

Coral reefs are formed from layers of calcium carbonate deposited over time by colonies of individual corals. These reefs provide homes for tens of thousands of species of marine plants and animals, making them among the world's most diverse and productive habitats. Nearly one-third of all fish species live on coral reefs,<sup>1</sup> while other species depend on the reefs and nearby seagrass beds and mangrove forests for critical stages of their life cycles.

**The Distribution of Coral Ecosystems**

Most coral reefs are found in shallow, clear ocean waters in tropical and semitropical areas. These warm-water corals derive significant food and energy from photosynthetic algae that live in symbiosis with the corals. Warm-water corals have raised intense interest in the last decade because of their apparent sensitivity to climate variability.

Other corals that do not depend directly on sunlight can form reef-like structures or banks at depths from one-hundred feet to more than three miles below the ocean's surface. While little is known about these deep-water structures, many scientists believe that their biological diversity may rival that of coral communities in warmer, shallower waters.<sup>2</sup>

Coral reefs are found in the waters of more than one-hundred countries, including the United States (Figure 21.1). They are particularly abundant in the South Pacific; Indonesian waters are estimated to include the largest proportion of corals, approximately 18 percent of the global total. U.S. waters include 1–2 percent of global warm-water corals.<sup>3</sup> Deep-water corals have been found around the globe, although little is known about their actual extent.

The National Oceanic and Atmospheric Administration (NOAA) estimates that U.S. coral reefs cover approximately 7,600 square miles. These reefs can be found in western Atlantic and Caribbean waters off Florida, Puerto Rico, the U.S. Virgin Islands, the Navassa Island National Wildlife Refuge (a small U.S. island territory near Haiti), and in the Pacific Ocean near Hawaii, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, and several remote, unincorporated Pacific island areas. Estimates of coral reef extent in the Pacific Freely Associated States (Palau, the Federated States of Micronesia, and the Marshall Islands) range from 4,500 to 31,500 square miles.<sup>4</sup>

**Figure 21.1. The Warm Water of the Tropics Is Home to the Majority of Known Reefs**



The locations of major coral reefs are seen as dots on this world map (reef area is not to scale). Most of the world's known reefs are found in tropical and semitropical waters, between 30° north and 30° south latitudes, although scientists have only begun to explore other cold-water coral communities.

Source: National Oceanic and Atmospheric Administration. <<http://www.coris.noaa.gov>> (Accessed January, 2004).

## The Value of Coral Ecosystems

Coral reefs are valued for their rich biological diversity as well as for the important ecosystem functions they serve. Reefs buffer shorelines from storms and erosion and provide homes, food, and nursery areas for tens of thousands of species of marine life. They are also the basis of thriving commercial and recreational fishing and tourism industries, and have the potential to provide beneficial medical applications. Coral reef ecosystems are estimated to provide a worldwide total of \$375 billion a year in goods and services, with approximately 500 million people dependent on these ecosystems for food, materials, or income.<sup>5</sup> In 2001, coral reefs in the Florida Keys alone supported \$105 million in income and more than 8,000 jobs.<sup>6</sup> Further, approximately one-half of all federally managed commercial fish species depend on coral reefs for at least part of their life cycle.<sup>7</sup>

Many people also value coral reefs for their unique aesthetic and cultural value. Coral reefs are an important part of the heritage of many countries, and the use of reef resources is integral to the social fabric of coastal communities. As one of the longest-lived and most beautiful ecosystems on Earth, their intrinsic value is incalculable.

## Threats to Coral Ecosystems

Coral reefs are declining at a disturbing pace.<sup>8</sup> The causes of this decline are varied, particularly for warm-water reefs. Many scientists believe that excessive fishing pressure has been the primary threat to coral ecosystems for decades.<sup>9</sup> However, pollution and runoff from coastal areas also deprive reefs of life-sustaining light and oxygen, and elevated sea surface temperatures are causing increasingly frequent episodes of coral bleaching and appear to be exacerbating other coral disease outbreaks.<sup>10</sup> Although little is known about the condition of the world's deep-water coral communities, extensive damage has been documented in some areas, with fishing activities suspected as being the largest human-related threat.<sup>11</sup>

Worldwide, no pristine, undamaged warm-water coral reefs remain, and one-third of the world's identified reefs are severely damaged.<sup>12</sup> In the United States, every warm-water reef system has suffered varying degrees of impacts from natural and human disturbances. Only the coral reefs in the Northwest Hawaiian Islands are in near-pristine condition, although they too have begun to show signs of damage, particularly from marine debris. In the U.S. waters of the south Atlantic, Gulf of Mexico, and Caribbean, two-thirds of reef fish species are overfished. In addition, during the 1990s, white band disease killed 90–96 percent of the most common nearshore species of corals.<sup>13</sup>

Coral communities have existed for millions of years and have developed mechanisms to cope with natural threats such as hurricanes, landslides, and predation. Often, when one part of a coral community is damaged, the overall functioning of the coral reef ecosystem is sustained by other, untouched communities that are able to repopulate damaged areas. However, the point is fast approaching where this natural cycle of repair may not be able to keep pace with the increasing rate of damage. Without immediate and large-scale protection from the cumulative impacts of a multitude of human activities, many reefs, particularly those located near heavily populated coastal areas, may soon be irretrievably harmed.<sup>14</sup>

## MANAGING U.S. CORAL RESOURCES

### Federal Agency Roles and Responsibilities

Although a number of longstanding environmental laws can be applied to the protection of coral reefs, the first legislation specifically targeted at coral reef issues, the Coral Reef Conservation Act, was passed in 2000. The Act focuses primarily on NOAA activities, requiring the agency to develop a national coral reef action strategy, initiate a matching grants program for reef conservation, and create a conservation fund to encourage public–private partnerships.

The Marine Protection, Research, and Sanctuaries Act (MPRSA) also provides protection for many coral reefs by authorizing NOAA to designate areas as marine sanctuaries and promulgate regulations for the conservation and management of those areas. Since the Act was passed in 1972, thirteen sanctuaries have been designated, several of which contain coral communities. Coral research, monitoring, and management activities are conducted in these sanctuaries, as well as in the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, which is currently under consideration to become the nation's fourteenth sanctuary.

The MPRSA includes a provision that allows NOAA to fund repairs to damaged habitats within sanctuaries, with cost recovery from responsible parties. However, the Act only allows funding for projects to repair immediate damage. For example, if a ship hits a reef, funds may be used to repair the damaged site, but not to install navigational aids to prevent other ships from damaging the reef in the future. Further, the funds cannot be used to remedy long-term chronic damages from pollution, nutrient overloading, or disease.

Other federal laws that are used to manage and protect coral reef resources include the following (a description of these and other federal statutes are included in Appendix D):

- The Magnuson–Stevens Fishery Conservation and Management Act, which allows for management of coral harvest and provides limited protections for corals if they are designated as “essential fish habitat.”
- The Coastal Zone Management Act, which provides for management of shoreline areas that may include coral reefs.
- The Clean Water Act, which regulates the discharge of dredged or fill materials into U.S. waters.
- The Sikes Act, which requires the U.S. Department of Defense to provide for conservation and rehabilitation of natural resources on military installations, which in some locations include corals.
- The Endangered Species Act, National Environmental Policy Act, and Lacey Act, all of which contain some provisions that can be applied to the protection of corals.

Responsibility for implementing these and other laws with implications for coral reef management is shared by a number of federal agencies. For example, the U.S. Environmental Protection Agency and the U.S. Department of Agriculture have regulatory and management responsibilities related to pollution from land-based sources. NOAA has the authority to regulate fishing in coral reef ecosystems. And action on global climate change is under the purview of many agencies, including the U.S. Department of Energy and the U.S. Department of State.

## **Interagency and Intergovernmental Coral Reef Management Initiatives**

### ***The U.S. Coral Reef Task Force***

The U.S. Coral Reef Task Force was created by Executive Order in 1998 with the purpose of improving coordination among the many agencies that manage various aspects of the nation's coral reef resources. Task force responsibilities include developing strategies to map and monitor U.S. coral reefs, studying the causes of and recommending solutions for coral reef degradation, and promoting conservation and sustainable use of coral reefs at the international level. Several broad action plans have been developed by the task force, although not all have been implemented.

The task force, which is co-chaired by the U.S. Departments of the Interior and Commerce, works primarily through consensus building among its member federal agencies and state and territorial government representatives. Two notable absences from the task force are the Department of Energy and the U.S. Army Corps of Engineers (USACE). The Department of Energy is actively involved in investigating the impact of global climate change on coral reefs. In addition, coral reefs are affected by many USACE projects, such as the construction of inland and shore structures, beach nourishment programs, and mooring permits.

### ***The U.S. All Islands Coral Reef Initiative***

The U.S. All Islands Coral Reef Initiative, a cooperative effort among Hawaii, American Samoa, Guam, the Commonwealth of Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands, is working to improve the management of coral reefs in island areas. Regional approaches that incorporate traditional knowledge are of particular interest to these islands, many of which share common cultural concerns about coral reef resources and manage similar threats, such as erosion, sea level rise, and degraded water quality.

## **Improving the Management of U.S. Coral Resources**

Despite recent management efforts, the health of coral reef ecosystems is continuing to decline at a rapid pace, demanding that further action be taken to overcome gaps and inefficiencies in the existing patchwork of laws, regulations, and agency programs. An improved governance regime is needed to better respond to coral reef management priorities at all levels (local, state, territorial, regional, and national), improve coordination among agencies, facilitate regional approaches, and implement national action on coral reefs. This regime should build on existing ideas and strategies of the U.S. Coral Reef Task Force, the U.S. All Islands Coral Reef Initiative, the Coral Reef Conservation Act, and the Marine Protection, Research, and Sanctuaries Act and task federal agencies with promulgation and enforcement of effective regulations to protect coral reef resources. Concerted support among all levels of government and increased public awareness are also essential for successfully implementing improved management strategies to achieve and sustain healthy coral reef ecosystems.

**Recommendation 21–1. Congress should pass, and provide sustained funding for, a Coral Protection and Management Act that covers research, protection, and restoration of coral ecosystems.**

*This legislation should include the following elements:*

- *support for mapping, monitoring, and research programs primarily through the National Oceanic and Atmospheric Administration and the U.S. Coral Reef Task Force.*
- *support for new research and assessment activities to fill critical information gaps, to be carried out in partnership with the academic research community.*
- *liability provisions for damages to coral reefs similar to those in the Marine Protection, Research, and Sanctuaries Act, but with greater flexibility to use funds in a manner that provides maximum short- and long-term benefits to the reef.*
- *support for outreach activities to educate the public about coral conservation and reduce human impacts.*
- *support for U.S. involvement, particularly through the sharing of scientific and management expertise, in bilateral, regional, and international coral reef management programs.*

In addition to new legislation directed specifically at improving the management of the nation's coral reef resources, a strengthened U.S. Coral Reef Task Force is needed to improve collaborative efforts at reducing the threats to these resources.

**Recommendation 21–2. Congress should codify and strengthen the U.S. Coral Reef Task Force and place it under the oversight of the National Ocean Council.**

*The task force should be strengthened in the following ways:*

- *Task force responsibilities should be expanded to include both warm-water and deep-water coral communities.*
- *the U.S. Department of Energy and the U.S. Army Corps of Engineers should be added as members of the task force.*
- *the task force should coordinate the development of regional ecosystem-based plans to address the impacts of nonpoint source pollution, fishing, and other activities on coral reef resources.*
- *the U.S. Environmental Protection Agency and the U.S. Department of Agriculture should work together to implement any pollution reduction goals developed by the task force.*
- *the National Oceanic and Atmospheric Administration, in consultation with Regional Fishery Management Councils, should implement any task force recommendations for reducing the effects of fishing on corals.*

## Promoting International Coral Reef Initiatives

The United States has been a leader in the management of coral reef ecosystems at the international level. The State Department, NOAA, the U.S. Agency for International Development, and the U.S. Fish and Wildlife Service contribute significantly to building enhanced management capacity in developing countries through direct funding and through training in areas such as research, enforcement, management procedures, and environmentally sustainable harvesting techniques.

The United States also participates in many international initiatives that protect coral reef resources, including the Convention on International Trade in Endangered Species (CITES), an international agreement designed to protect species from over-exploitation by prohibiting trade with countries that cannot certify that their harvest of these species is not detrimental to their survival. Over 2,000 species of coral are listed under CITES. The International Coral Reef Initiative (ICRI) was developed in 1994 as an informal mechanism to develop the best strategies for conserving the world's coral reef resources. ICRI membership is made up of over eighty developing countries, donor countries, and development banks, international environmental and development agencies, scientific associations, the private sector, and nongovernmental organizations. ICRI's Global Coral Reef Monitoring Network has published the only global estimates of coral reef coverage and status, although the accuracy of these estimates could be improved.<sup>15</sup>



## Creating More Sustainable Harvesting Practices

As the world's largest importer of ornamental coral reef resources,<sup>16</sup> the United States has a particular responsibility to help eliminate destructive harvesting practices and ensure the sustainable use of these resources. Many of these resources are harvested by methods that destroy reefs and overexploit ornamental species. A balance is needed between sustaining the legitimate trade in ornamental resources and sustaining the health and survival of the world's coral reef resources.

The Tropical Forest Conservation Act of 1998 offers a potential model for the role of the United States in curbing destructive harvesting practices. The Act authorizes the President to reduce debt owed to the United States if a developing country establishes a tropical forest management program and uses funds freed from the debt reduction agreement to support tropical forest conservation. Applying this type of program to the management of international coral reef resources could greatly enhance the ability of the United States to promote stewardship and conservation of coral reef ecosystems around the world.

**Recommendation 21–3. The National Oceanic and Atmospheric Administration should develop national standards—and promote international standards—to ensure that coral reef resources that are collected, imported, or marketed are harvested in a sustainable manner. The U.S. Department of State should implement incentive programs to encourage international compliance with these standards.**

## IMPROVING UNDERSTANDING OF CORAL ECOSYSTEMS

Improved research and data collection activities are needed to better understand coral reef ecosystems and the impact of human activities on these ecosystems. The Integrated Ocean Observing System (IOOS), discussed in Chapter 26, is intended to become an integrated and continuous monitoring system encompassing all ocean environments, including coral communities. More finely tuned measurements of temperature and currents—and corresponding changes in coral communities—will allow scientists to understand and better predict the impacts of global climate change and other natural and human-induced events on coral communities. In addition, NOAA is working on a set of comprehensive maps of U.S. coral reefs that will incorporate an assessment of the current status of these reefs.

As the IOOS and other data collection programs (including the regional ocean information programs discussed in Chapter 5) move forward, the U.S. Coral Reef Task Force can provide guidance on information needs. This new information can then support further ecosystem-based research and management plans.

**Recommendation 21–4. The U.S. Coral Reef Task Force should identify critical research and data needs related to coral reef ecosystems. These needs should guide agency research funding and be incorporated into the design and implementation of the Integrated Ocean Observing System.**

*The task force should:*

- *develop regional, ecosystem-based research plans designed to protect and restore coral reef ecosystems, including deep-water coral communities.*
- *coordinate its efforts with the regional ocean information programs.*

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- <sup>1</sup> National Marine Fisheries Service. <[http://www.nmfs.noaa.gov/prot\\_res/PR/coralhome.html](http://www.nmfs.noaa.gov/prot_res/PR/coralhome.html)> Accessed February, 2004.
- <sup>2</sup> Oceana. *Deep Sea Corals*. Washington, DC, 2003.
- <sup>3</sup> Global Coral Reef Monitoring Network. *Status of Coral Reefs of the World: 2002*. Ed. C. Wilkinson. Cape Ferguson, Queensland: Australian Institute of Marine Science, 2002.
- <sup>4</sup> National Oceanic and Atmospheric Administration. *State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2002*. Silver Spring, MD, 2002.
- <sup>5</sup> Global Coral Reef Monitoring Network. *Status of Coral Reefs of the World: 2002*. Ed. C. Wilkinson. Cape Ferguson, Queensland: Australian Institute of Marine Science, 2002.
- <sup>6</sup> Johns, G.M., et al. *Socioeconomic Study of Reefs in Southeast Florida*. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Ocean Service, 2001.
- <sup>7</sup> National Oceanic and Atmospheric Administration. *A National Coral Reef Action Strategy. Report to Congress on Implementation of the Coral Reef Conservation Act of 2000 and the National Action Plan to Conserve Coral Reefs in 2002–2003*. Silver Spring, MD, June 2002.
- <sup>8</sup> Pandolfi, J.M., et al. "Global Trajectories of the Long-Term Decline of Coral Reef Ecosystems." *Science* 301 (2003): 955–58.
- <sup>9</sup> National Oceanic and Atmospheric Administration. *State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2002*. Silver Spring, MD, 2002.
- <sup>10</sup> Hughes, T.P., et al. "Climate Change, Human Impacts, and the Resilience of Coral Reefs." *Science* 301 (2003): 929–33.
- <sup>11</sup> Oceana. 2003. *Deep Sea Corals*. Washington, DC, 2003
- <sup>12</sup> National Oceanic and Atmospheric Administration. *A National Coral Reef Action Strategy. Report to Congress on Implementation of the Coral Reef Conservation Act of 2000 and the National Action Plan to Conserve Coral Reefs in 2002–2003*. Silver Spring, MD, June 2002.
- <sup>13</sup> National Oceanic and Atmospheric Administration. *State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2002 Report*. Silver Spring, MD, 2002.
- <sup>14</sup> Pandolfi, J.M., et al. "Global Trajectories of the Long-Term Decline of Coral Reef Ecosystems." *Science* 301 (2003): 955–58.
- <sup>15</sup> Global Coral Reef Monitoring Network. *Status of Coral Reefs of the World: 2002*. Ed. C. Wilkinson. Cape Ferguson, Queensland: Australian Institute of Marine Science, 2002.
- <sup>16</sup> National Oceanic and Atmospheric Administration. *A National Coral Reef Action Strategy. Report to Congress on Implementation of the Coral Reef Conservation Act of 2000 and the National Action Plan to Conserve Coral Reefs in 2002–2003*. Silver Spring, MD, June 2002.

