

GOAL 3: CONDUCT STRATEGIC RESEARCH

KEY THREATS ADDRESSED

Conducting strategic research provides information critical to reducing key threats to coral reef ecosystems. The figure below is a general summary of the relative importance (H = high, M = medium, L = low) of this goal in addressing the impacts from these threats. A higher ranking suggests that activities under this goal are considered more important to addressing the threat. Lower rankings suggest that although activities under this goal may make significant contributions, they may currently be less important to addressing the threat. The rankings are a summary of input shown in Table 2. The actual importance of this goal to addressing threats to reefs will depend on location and other factors (see Tables 3 and 4 for regional comparisons).

THREATS	Global warming/ climate change	Diseases	Hurricanes/ typhoons	Extreme biologic events	Overfishing	Destructive fishing practices	Habitat destruction	Invasive species	Coastal Development	Coastal pollution	Sedimentation & runoff	Marine debris	Overuse from tourism	Vessel groundings	Vessel discharges
Conduct Strategic Research	H	H	M	H	H	M	M	M	H	H	H	L	M	L	L

RATIONALE FOR ACTION

The underlying causes of reef decline are diverse and include over-exploitation, pollution and sedimentation, habitat destruction, invasive species, increasingly severe bleaching events, disease outbreaks and global climate change. These and other key processes remain only partially understood, and this paucity of knowledge hampers effective management actions needed to conserve and sustainably manage coral reef ecosystems. For instance, it is clear that new diseases are emerging at an accelerated rate, and mortality from disease has modified the structure and composition of coral reefs across the Caribbean by removing common and locally abundant species. However, most diseases have not been critically or thoroughly characterized, disease etiologies remain largely unknown, and most cause and effect relationships are not well documented.

The policy and decision-making processes necessary for effective conservation of reef ecosystems are influenced by equally complex socioeconomic and political systems. Important decisions such as the establishment of MPAs, implementation of fishery regulations, or regulation of coastal development usually cover large spatial scales and may be in effect for long time periods. They involve the integration of a wide range of interlinked considerations, but are often based on limited biophysical and socioeconomic information. The science in support of these decisions is often conducted on much smaller spatial and temporal scales. In many cases the science is highly specialized with results that are difficult to apply directly to policy decisions, or the science may be completely lacking. The ability to halt and reverse degradation of coral reef ecosystems depends on developing a better understanding of the structure and function of coral reef ecosystems, how human activities influence coral reefs, and then using this understanding in making management decisions that sustain and restore coral reef ecosystems.

RESEARCH STRATEGY

The strategy to achieve this goal is outlined in the U.S. National Action Plan to Conserve Coral Reefs and associated documents of the Ecosystem Science and Conservation working group of the U.S. Coral Reef Task Force. This strategy relies on coordinating research among agencies, academia, industry, and NGOs to address the priority research and management needs. The goal is to develop a nationally coordinated research program by fulfilling the following three objectives:

- Objective 1: Conduct a long-term regional and ecosystem-based research program to improve our understanding of processes that govern the structure, function, and health of coral reef ecosystems.
- Objective 2: Build capabilities to address ecosystem-scale threats such as disease, bleaching and other sources of mass mortalities.
- Objective 3: Develop and transfer technology for faster and more accurate mapping, assessment, monitoring, and restoration.

SUMMARY OF ACCOMPLISHMENTS (2001)

The following is a partial summary of recent accomplishments by members of the U.S. Coral Reef Task Force and other partners to achieve the Strategic Research goal and objectives. Information was provided by the Ecosystem Science and Conservation working group and members of the U.S. Coral Reef Task Force. For more detailed information on accomplishments

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in this area please see <http://coralreef.gov/> or contact specific members of the U.S. Coral Reef Task Force.

Objective 1 Accomplishments:

- Sponsored \$8 million of new coral reef projects and continued 25 ongoing studies. (NSF)
- Dedicated over \$4M million to support coral reef-related research projects through NOAA's Sea Grant Program and National Undersea Research Program. (NOAA)
- Continued to support the Hawaii Coral Reef Initiative Research Program and the National Coral Reef Institute, programs that bring the scientific community together to focus on critical coral issues. (NOAA)
- Developed and refined a model to track and predict the effects of biotic and physical changes in the (MHI) and the (NWHI) (NOAA, DOI, Hawaii and partners).
- Examined natural processes regulating coral survival and mortality in no-take MPAs and reference areas in the Florida Keys; focused on the effects of predators and disease on juvenile and adult corals (NOAA, DOI).
- Studied movement patterns of commercially important grouper species and provided managers information on juvenile goliath grouper home range, activity areas, habitat and micro-habitat utilization, and seasonal movements (NOAA).
- Deployed current tracking devices to assess how protected areas in the (NWHI) coral reef ecosystem contributes to larval fish transport and recruitment throughout Hawaii (multiple partners).

Objective 2 Accomplishments:

- Developed a pilot Coral Health and Disease Consortium (CHDC) to help coordinate and lead efforts to organize scientific resources to investigate diseases and bleaching of coral reef ecosystems, the effect of anthropogenic, climatic, and natural factors on the transmission of coral diseases and the emergence of new diseases, and the identification of the biotic and abiotic agents responsible for the diseases (NOAA, EPA, DOI, academic and private sector partners).
- Initiated development and testing of a novel environmental biotechnology approach to diagnose cellular and physiological responses of indicator species to environmental stressors (NOAA, academic and private sector partners).
- Continued examining coral disease dynamics and the natural and environmental factors affecting coral defense mechanisms (NOAA, EPA, DOI, industry and academic partners).

- Continued assessing the prevalence of disease and bleaching in the Florida Keys and the effects of various water quality parameters and climate change indices (EPA, NOAA, and academic partners).
- Initiated development of an Index for Biological Integrity to evaluate the condition of coral reef ecosystems (NOAA, NPS, EPA, academic and private sector partners).
- Characterized responses of corals and symbiotic algal cultures to climate change through exposure to altered UV and elevated temperatures (NOAA, EPA, academic and private sector partners).
- Began testing an integrated molecular biomarker system to assess the health of coral reef ecosystems in the Florida Keys (NOAA and partners).

Objective 3 Accomplishments:

- *See accomplishments listed under the following goal areas: Map all U.S. Coral Reefs (p 20), Assess and Monitor Reef Health (p 27); and Reduce Pollution (p 62).*

IMPLEMENTATION PLAN 2002-2003

The Ecosystem Science and Conservation working group of the U.S. Coral Reef Task Force is identifying priority actions to address research needs for effective coral reef conservation and management, working with many partners. The following is a partial summary of key actions to be implemented by a variety of partners in 2002-2003 to help fulfill the goal and objectives. Additional recommendations are outlined in several recent meetings on research priorities in coral reef conservation (International NCORE workshop <http://www.ncoremiami.org/documents.html>, 9th International Coral Reef Symposium). More detailed information is available from the working group or member organizations of the U.S. Coral Reef Task Force (<http://coralreef.gov/>).

To Address Objective 1:

- Increase research on coral reef ecosystem function by initiating a Coral Reef Ecosystem Studies (CRES) program to support management-oriented research to improve understanding of the interactions between human activities and coral health with emphasis on U.S. reefs affected by significant anthropogenic and natural stresses.
- Develop a whole-ecosystem, hypothesis-based approach to rank and monitor the causes of coral reef declines within regions and provide management strategies to reverse or mitigate further degradation.
- Evaluate the reef status and function at little known reef areas such as Navassa Island.
- Increase research on fisheries and coral reefs:
 - Map spatial distribution of trap fishing efforts in the U.S. Caribbean, assess gear techniques of local fishers, and evaluate trap and fishing effects on coral habitat.

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- Expand and refine Ecopath and similar ecosystem modeling to evaluate options and specific implications of management plans for coral reef resources.
- Improve our understanding of larval pathways, trophic interactions and their ecosystem impacts associated with fishing, as well as habitat impacts associated with certain types of fishing gear and practices.
- Quantify and model the ecosystem effects of fishing, and increase biophysical and socioeconomic knowledge for effective reef fisheries management.
- Increase research to define sustainable yields of larger coral reef fishes and invertebrates.
- Increase research on use of no-take reserves (reserves) and other types of MPAS in coral reef systems:
 - Evaluate herbivory processes on reefs in the FKNMS, including a comparison of no-take reserves and reference sites.
 - Assess the role that existing marine reserves serve as a source of reef fish adults and larvae to repopulate other reef habitats. Assess how reserve size and connectivity affects reserve function.
- Continue evaluation of the ecological health of deep reefs and habitat requirements for deep-water groupers, including recently identified spawning aggregation sites, to guide management efforts to protect habitat utilized by grouper species listed as Candidates for the Environmental Protection Agency (EPA).
- Conduct ecological research on deep water coral assemblages and the surrounding communities, including potential natural products and resources.
- Increase research to understand how reef systems are connected on local to regional scales:
 - Complete a genetic assessment of Caribbean Acroporid populations to determine the genetic relatedness (connectivity) among reef areas for the evaluation the potential of dispersal to and re-population of areas of extirpation.
 - Identify and quantify chemical contaminants transported in African dust events and linkages to coral health.
 - Improve understanding of reef processes such as larval recruitment and retention, reef connectivity, and patterns of biodiversity and reef structure.
- Increase research on interactions between land-based activities (including run-off, sedimentation, nutrient loading, etc.) and coral reef ecosystem health by conducting regional assessments of large-scale phenomenon to better understand the impacts of human activities and reefs.
- Strengthen research on the taxonomy, systematics, and phylogeny of coral reef ecosystem species.
- Examine the nature of, and relationships between, local and large-scale oceanographic processes by developing predictive models of regional oceanographic processes at a variety of time and space scales.

To Address Objective 2:

- Provide support and partnerships to establish the Coral Health and Disease Consortium (CHDC).
- Host the First Annual CHDC Workshop and develop a National Action Plan for Coral Disease Research to promote effective detection, identification and management of coral reef diseases, identify key impediments and recommend strategic research priorities.
- Develop a web-based, user-friendly coral disease identification system linked to the existing Coral Health and Monitoring Program (CHAMP) and other coral information Web sites.
- Expand the Global Coral Disease Database to provide access to unpublished reports from monitoring programs, a coral disease identification Compact Disk for volunteer divers, and a volunteer-diver reporting system to improve our ability to identify disease outbreaks.
- Host a training workshop for Puerto Rico on disease identification and monitoring.
- Develop and field-test innovative tools for assessing, monitoring, restoring and managing coral reef ecosystems.
- Develop models and/or data syntheses to assist resource managers in assessing alternative management strategies to understand and improve the conditions of reefs and to protect healthy reef areas.

To Address Objective 3:

- *See actions listed under the following goal areas: Map all U.S. Coral Reefs(p 22), Assess and Monitor Reef Health (p 27); Reduce Pollution (p 64).*