GOAL 1:
MAP ALL U.S. CORAL REEF ECOSYSTEMS

KEY THREATS ADDRESSED:

Mapping coral reefs will help address and reduce a number of 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 reducing 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 Biotic Events	Overfishing	Destructive Fishing Practices	Habitat Destruction	Invasive Species	Coastal Development	Coastal Pollution	Sedimentation & Runoff	Marine Debris	Overuse from Tourism	Vessel Groundings	Vessel Discharges
Map All U.S. Coral Reef Ecosystems	**M**	**M**	**L**	**L**	**H**	**M**	**H**	**L**	**H**	**H**	**M**	**L**	**M**	**M**	**L**

RATIONALE FOR ACTION:

Accurate geo-referenced information on the exact location of specific natural resources and habitat types is essential for effective management of any marine habitat. This need is particularly acute for coral reef ecosystems where reef-dwelling communities may be very different over short distances and where the consequences of misinformed management decisions, such as the placement of potentially harmful human activities, can have devastating and lasting ecological consequences. Comprehensive maps and habitat assessments form the foundation for a variety of reef conservation measures including: creating accurate baselines for long-term monitoring; identifying and protecting essential fish habitat; illustrating important community-scale trends in coral reef ecosystem conditions over time; characterizing habitats for place-based conservation measures such as marine protected areas (MPAs); and enabling scientific understanding of the large-scale oceanographic and ecological processes affecting reef

health. Habitat maps will also help managers predict the impacts of natural and anthropogenic stresses such as disease outbreaks, hurricanes, harmful algal blooms, oil spills, vessel groundings, and coastal pollution, run-off, and development. Thus recent, accurate, and carefully designed mapping products are a cornerstone of most coral reef ecosystem conservation and management efforts.

MAPPING STRATEGY:

The strategy to achieve this goal is outlined in the U.S. National Action Plan to Conserve Coral Reefs and related documents of the Mapping and Information working group of the U.S. Coral Reef Task Force. For more detailed information see http://coralreef.gov/. The mapping strategy outlines four major objectives to (1) produce comprehensive digital maps of all shallow (< 30 meters) coral reefs and (2) characterize priority deep water (> 30 meter) reef systems in the U.S. and Trust Territories by 2009.

Objective 1: Develop high-resolution benthic maps and coastline surveys of local and regional coral reef ecosystems using satellites, aircraft, and *in situ* surveys, with particular emphasis on MPAs, reefs at risk of degradation due to human activities, and other priority sites identified by the U.S. Islands representatives.

Objective 2: Develop large-scale, low-resolution maps of broad coral reef ecosystems throughout U.S. waters using satellites and other remote sensing assets for use in characterizing habitats, designing monitoring programs, and planning regional conservation measures such as MPAs.

Objective 3: Develop and adapt new technologies and data sources to enhance coral reef ecosystem mapping, survey, and assessment capabilities to detect important ecological changes and trends.

Objective 4: Characterize priority deep water reefs and associated habitats.

SUMMARY OF ACCOMPLISHMENTS (2001)

The following is a partial summary of recent accomplishments to achieve the objectives. The information was provided by the Mapping and Information Working Group of the U.S.. Coral Reef Task Force. Efforts to map and characterize shallow coral reef ecosystems (< 30 m) have been implemented by multiple partners using a range of technologies based on the Mapping and Information working group implementation plan (see http://coralreef.gov). Some

characterization of deep coral reef areas (> 30 m) has also been initiated, although a comprehensive implementation plan has not been developed for characterizing deep reef areas.

General Accomplishments:

- Published *A Strategy to Map State, Commonwealth, Territory, and Freely Associated State Coral Reef Ecosystems in the U.S.* (see http://coralreef.gov). (Mapping and Information Working Group)
- Published the *Coral Reef Mapping Implementation Plan: Mapping and Information Synthesis Working Group of the U.S. Coral Reef Task Force* (see http://coralreef.gov). (Mapping and Information Working Group)

Objective 1 Accomplishments:

- Completed mapping and produced and distributed Geographic Information System (GIS) maps and associated metadata of the shallow-water coral reef ecosystems of the U.S. Virgin Islands and for Puerto Rico. (NOAA and partners).
- Collected ship-based sidescan and multibeam data for selected areas under consideration for inclusion in the Tortugas Ecological Reserve (Florida Keys coral reef ecosystem). These data are currently being processed into digital map products. (NOAA and partners)
- Conducted geological research and related site specific mapping of coral reefs in the Florida Keys. (DOI)
- Obtained high-resolution satellite imagery and high-altitude hyperspectral data over portions of the Northwestern Hawaiian Islands (NWHI) and determined the location of land areas in the NWHI. (NOAA, NASA)
- Gathered over 1,100 site-specific seabed characterizations, including Geographic Positioning System, (GPS) water depth, and seabed habitat information, and Remotely Operated Vehicle (ROV) imagery, for the shallow-water coral reef ecosystems and bank areas in the NWHI. (NOAA, DOI, University of Hawaii)
- Developed and tested computer-based analyses of high-resolution satellite imagery to generate estimated shallow-water bathymetry. (NOAA)
- Obtained high-resolution satellite imagery for islands of American Samoa, Guam, all of the islands of the Commonwealth of the Northern Marianas, and Howland Island, Baker Island, and Jarvis Islands. Imagery has been ordered for Palmyra Atoll. (NOAA, DOI and partners)
- Initiated the processing of the high-resolution and moderate-resolution satellite imagery of U.S. flag and freely associated states in the Pacific. This processing will be completed in 2002-2003. (NOAA and partners)
- Conducted mutli-beam mapping of the seafloor at 5 locations in American Samoa. (NOAA and partners)

- Completed first phase of updating coastal atlas in Guam. (Guam)
- Conducted baseline assessment and mapping of coral reefs on the eastern end of Vieques, Puerto Rico. (DOD)

Objective 2 Accomplishments:

- Developed the first generation of a global, low-resolution, global ocean color map using SeaWiFS satellite imagery. This map depicts areas where ocean color may be indicative of shallow-water habitats, including sand and water containing chlorophyll. These data are available online by visiting (http://seawifs.gsfc.nasa.gov/reefs). (NASA)
- Acquired aerial photographs, digital hyperspectral images, and high-altitude AVIRIS hyperspectral data for portions of the eight main Hawaiian Islands. Established cooperative programs with the university and private sector to conduct the in-situ data gathering efforts and develop the draft coral reef maps for portions these areas. (multiple partners)
- Analyzed comparative advantages of aerial photography and hyperspectral imagery for mapping shallow-water coral reefs in Hawaii (see accomplishment report for results). (multiple partners)
- Obtained moderate-resolution satellite imagery of Guam, Commonwealth of the Northern Marianas Islands (CNMI), portions of American Samoa, Palmyra Atoll, and Wake Island. (NOAA, DOI)
- Obtained moderate-resolution satellite imagery of portions of the Republic of the Marshall Islands, Federated States of Micronesia, and the Republic of Palau. (multiple partners)

Objective 3 Accomplishments:

- Developed a web-based tool for accessing digital aerial photography of USVI and Puerto Rico coral reefs (see http://biogeo.nos.noaa.gov/benthicmap/caribbean). (NOAA and partners)
- Developed classification schemes for identifying seabed habitats visible in digital imagery in the Caribbean, main Hawaiian Islands, the Northwestern Hawaiian Islands and portions of American Samoa (Fagatele Bay National Marine Sanctuary). (NOAA and partners)

Objective 4 Accomplishments:

- Completed multi-beam sonar mapping of major areas of the Northeastern Gulf of Mexico, including the new Madison-Swanson and Steamboat Lumps Marine Protected Areas. These areas were recently protected as important habitats for commercial reef fishes and contain some deep reefs that may rival those found in the Flower Gardens National Marine Sanctuary. (NOAA and partners)

IMPLEMENTATION PLAN 2002-2003

The Mapping and Information Synthesis working group of the U.S. Coral Reef Task Force is continuing to coordinate efforts to map all shallow U.S. coral reef ecosystems by 2007. A detailed implementation plan is available at http://coralreef.gov/. Successful implementation of the plan will require the continued support, commitment and collaboration of federal, state, and territorial agencies. The following is a partial summary of key actions needed from government and non-governmental entities in FY 2002 –2003 to help fulfill the goal and objectives.

To address Objective 1.

- Distribute a CDROM-based digital data product containing GIS maps and associated metadata of the shallow-water coral reef ecosystems of the USVI and Puerto Rico.
- Expand the existing web-based tool for the coral reefs ecosystems of the USVI and Puerto Rico to include downloadable coral reef maps and photo-mosaics.
- Complete coral reef ecosystem maps for 30 percent of the coast of the eight main Hawaiian Islands and initiate map production for the remaining areas.
- Initiate a project to produce coral reef maps for all shallow-water coral reefs of the eight main Hawaiian Islands.
- Process high-resolution and moderate-resolution satellite imagery for coral reef mapping activities in the NWHI and other Pacific areas.
- Improve the computer-based analysis of high-resolution and moderate-resolution satellite imagery to generate coral reef ecosystem maps and estimated shallow-water bathymetry.
- Acquire high-resolution satellite imagery of a portion of the Republic of Palau and make geo-referenced coral reef ecosystems maps and imagery and maps available to the government of the Republic of Palau and its partners.
- Develop a plan for acquiring shallow to moderate depth bathymetric data for priority areas in the NWHI.
- Assess the usefulness of manta-tow video imagery from the Northwestern Hawaiian Islands for shallow-water coral reef mapping efforts.

To address Objective 2:

- Update and reprint the nautical charts of the NWHI.
- Acquire additional moderate-resolution satellite imagery of U.S. Pacific islands and freely-associated states in the Pacific.

- Acquire satellite imagery of other U.S. flag islands, such as Wake Atoll, Johnston Atoll, and Kingman Reef in the Pacific, and Navassa in the Caribbean.

To address Objective 3:

- Develop a plan to revise and update the coral reef ecosystem maps of the Florida Keys using new technologies to improve detail and accuracy.
- Conduct research to determine the ability to map using hyperspectral and Ikonos sensors for mapping and characterizing reefs.

To address Objective 4:

- Identify, prioritize key sites and complete a 3 year plan for mapping U.S. deep-water coral reef ecosystems.
- Launch deep-water coral reef mapping efforts in the NWHI and USVI.
- Complete priority deepwater reef mapping projects: *Oculina* Research Reserve in Federal waters off the East Coast of Florida; Madisson Swanson Reserve off the West Florida Shelf, and Hind Bank Reserve off the USVI.