

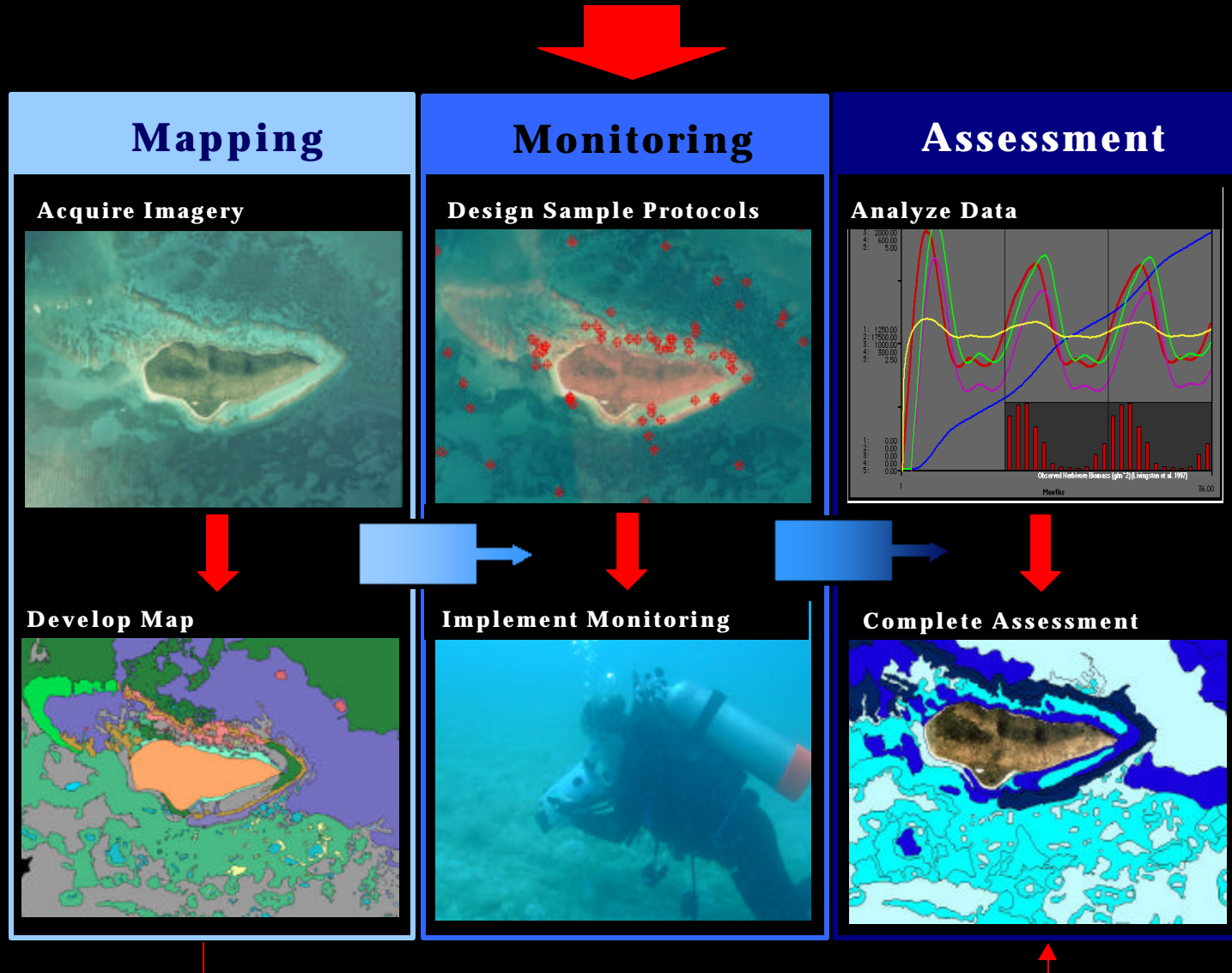
U.S. Coral Reef Ecosystem Mapping

A Pacific Regional Status Report



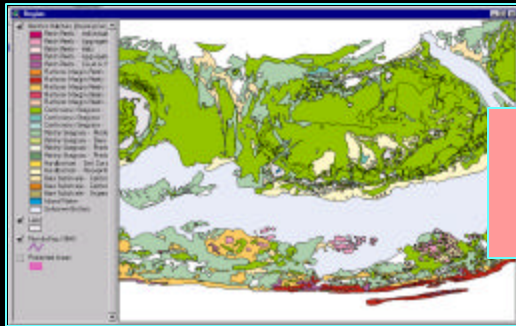
Integrative Mapping, Monitoring & Assessment

National Coral Reef Ecosystem Assessment Process



A Strategy to Map U.S. Shallow-water Coral Reef Ecosystems

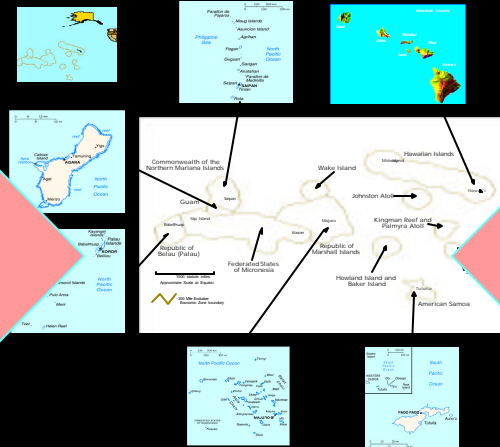
The Mapping Model: Florida Keys Corals, 1992-1998



Aerial photography
Unclassified images
Classified images
Digital Maps

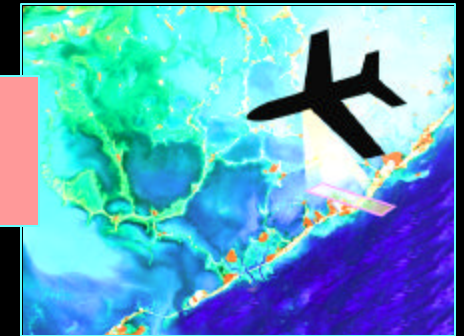
Information transfer:
Website
CD-ROM Product
11" x 17" Atlas Product

The Challenge: Mapping Pacific Corals, 1999-2007



Pacific Coral Reef Study Area:
Main Hawaiian Islands
NW Hawaiian Islands
Guam
American Samoa
Northern Marianas
FAS

Improved Mapping Capabilities: Puerto Rico and U.S. Virgin Islands, 1998-2000

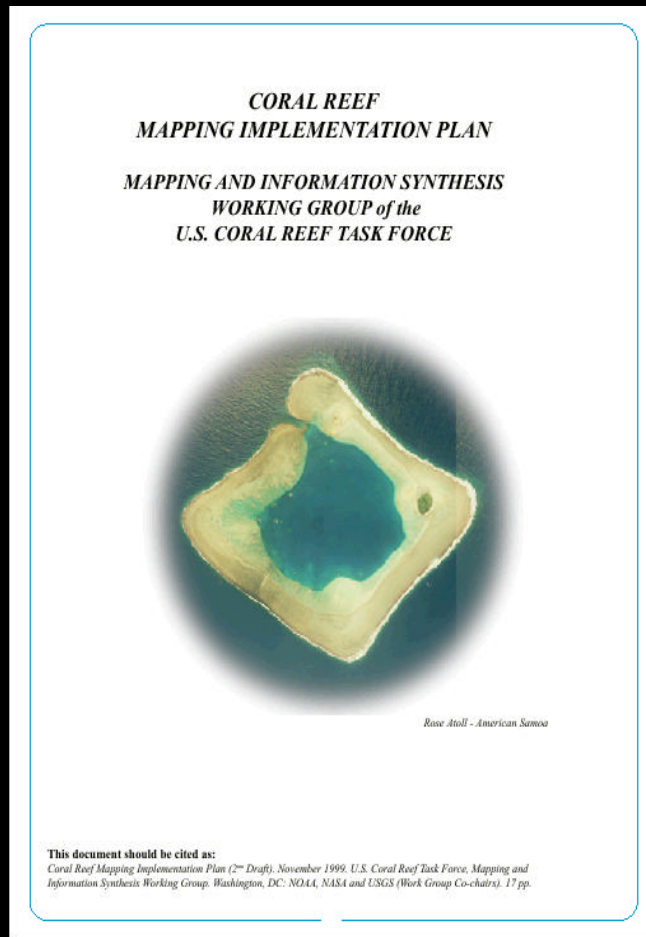


**Aerial Photography and
Hyperspectral Imaging for
Habitat Classification**

Transferable Methods:
Classification Scheme
Digital Imagery
Classified Digital Maps
Methods Manual

U.S. Coral Reef Task Force

Coral Reef Mapping Implementation Plan



- **Map All U.S. States, Territories, Commonwealths & the FAS by 2007**
- **Delineate benthic habitats using hierarchical classification system**
- **Use a suite of technologies to collect imagery and associated data, including bathymetry**
- **Generate digital, high resolution maps of shallow (< 30 m) coral reef ecosystem habitats**
- **Integrate maps with research & monitoring activities for use by researchers and managers**



U.S. Coral Reef Task Force

Moderate Depth Coral Reef Mapping Implementation Plan

Mapping Moderate Depth Habitats of the U.S. Pacific Islands with Emphasis on the Northwestern Hawaiian Islands: an Implementation Plan

Version 2
August 2003

About this Document

This Mapping Implementation Plan (MIP) presents a comprehensive framework for the development of moderate depth (<20-200fm) bathymetric and habitat maps of the Northwestern Hawaiian Islands (NWHI). It also discusses the need to develop similar bathymetric and habitat maps for the main Hawaiian Islands and U.S.-affiliated Pacific Islands (American Samoa, Guam, and the Northern Marianas).

The plan has been developed with extensive input from the National Marine Fisheries Service-Pacific Islands Fisheries Science Center (PIFSC), the Western Pacific Regional Fisheries Management Council (WPRFMC), the office of the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve (CRER), and the National Ocean Service's Office of the Coast Survey (OCS).

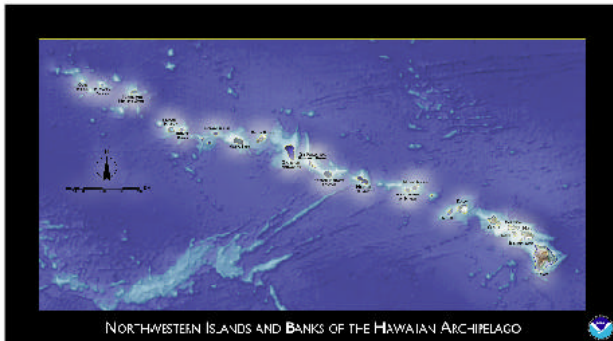
This MIP has been developed to complement the Coral Reef Mapping Implementation Plan (2nd Draft) released in 1999 by the U.S. Coral Reef Task Force's Mapping and Information Synthesis Working Group. While recognizing the need to produce bathymetry and habitat maps of deepwater areas, that Plan focused on using remote sensing technologies, such as aerial photography and satellite imagery, to map the shallow-water (<20 fm) areas of the U.S. The completion of the mapping activities described in both this MIP and the 1999

Plan will result in comprehensive, detailed maps of all U.S. coral reef ecosystems.

Before the NWHI portion of this MIP can be finalized, further input will be needed to address the overlapping mapping requirements of other organizations, especially the Hawaii Department of Land and Natural Resources, the U.S. Fish and Wildlife Service, and the University of Hawaii. Some of that input was obtained at the recently held "Information Needs for Conservation and Management: A Workshop on the Northwestern Hawaiian Islands." The results of that workshop, held on 13-15 May 2003 in Hawaii and attended by over 100 people, have been incorporated into this MIP.

Before the main Hawaiian Islands and U.S.-affiliated Pacific Islands portion of this MIP is finalized, input will be needed from organizations responsible for managing and conserving the coral reef ecosystems of Hawaii, American Samoa, Guam, and the Northern Marianas. Input will be obtained through review of this draft MIP and ongoing discussions related to bathymetric and habitat mapping priorities in these areas.

This MIP presents a framework for mapping the U.S. Pacific region and should be considered an evolving document. As priorities change, funding varies, new data are collected, and new technologies become available, the information presented



- **Focuses on mapping deeper (>30 m) coral habitats**
- **Recommends using a combination of LIDAR and ship-based (e.g., multibeam) technologies**
- **Recognizes the need to collect seafloor characterization information using drop cameras, ROVs, AUVs, etc.**
- **Emphasizes the need for data management and processing to generate mapping products**
- **Recognizes need for mission flexibility (a draft January 2004 update available from NMFS)**



Mapping Coral Reef Ecosystems

Success depends on Partnerships

- **State and territorial government agencies** (e.g., the Hawaii Department of Land and Natural Resources; the Palau Bureau of Lands and Surveys)
- **Universities** (e.g., the University of Guam; the University of Hawaii)
- **Other federal government agencies** (e.g., the National Park Service; the Natural Resources Conservation Service; the US Geological Survey)
- **Nonprofit agencies** (e.g., The Nature Conservancy; the Micronesia Conservation Trust)
- **Private companies** (e.g., Space Imaging; Analytical Laboratories of Hawaii)

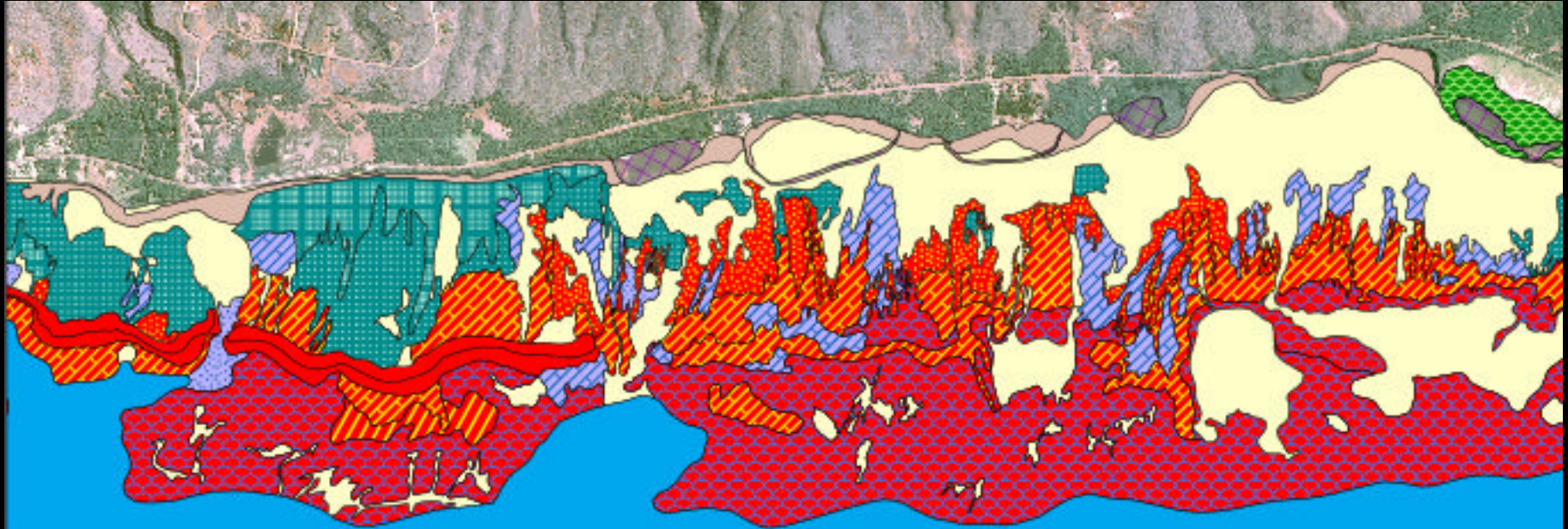


Suite of Remote Sensing Technologies

- **Digital Aerial Photography** ———— [High Spatial Resolution
Visual Interpretation to
Large # of Classes
 - **Hyperspectral Imagery** ———— [High Spatial Resolution
Robust Spectral Resolution
 - **Satellite**
 - ~ **SeaWifs** ———— Low Spatial Resolution
 - ~ **Landsat** ———— Moderate Spatial Resolution
 - ~ **IKONOS** ———— High Spatial Resolution
 - **Ship-based Instruments** ———— [Mini-Bat Validation of
Remotely Sensed Imagery
Roxanne/QTC
Sidescan & Multibeam
 - **Diver Validation**
-



Mapping of the Main Eight Hawaiian Islands



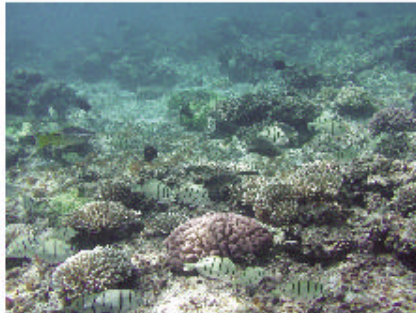
South Shore, Molokai

Habitat Types

 Sand	 Encrusting Coraline Algae/10%-50%	 Colonized Pavement with Sand Channels
 Mud	 Linear Reef	 Uncolonized Pavement
 Seagrass/90%-100%	 Spur and Groove Reef	 Reef Rubble
 Seagrass/50%-90%	 Patch Reef/Individual	 Uncolonized Volcanic Rock/Boulders
 Seagrass/10%-50%	 Patch Reef/Aggregated	 Uncolonized Pavement with Sand Channels
 Macroalgae/90%-100%	 Coral Head/Individual	 Emergent Vegetation
 Macroalgae/50%-90%	 Coral Head/Aggregated	 Artificial
 Macroalgae/10%-50%	 Scattered Coral/Rock in Unconsolidated Sediments	 Artificial/ Fishpond
 Encrusting Coraline Algae /90%-100%	 Colonized Pavement	 Unknown
 Encrusting Coraline Algae/50%-90%	 Colonized Volcanic Rock/Boulder	

Mapping of the Northwestern Hawaiian Islands

Atlas of the Shallow-water Benthic Habitats of the Northwestern Hawaiian Islands **DRAFT**

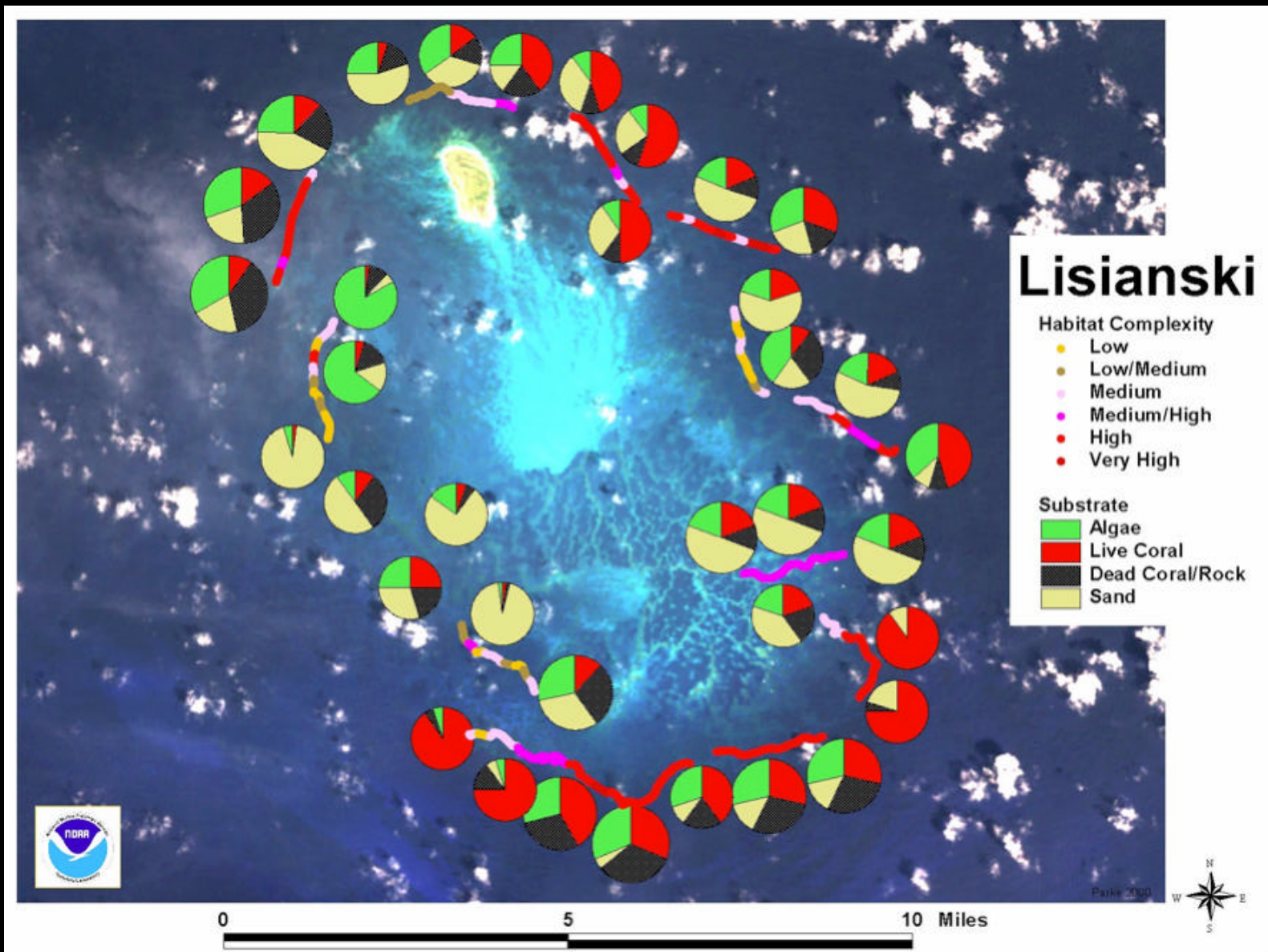


U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service

March 2003



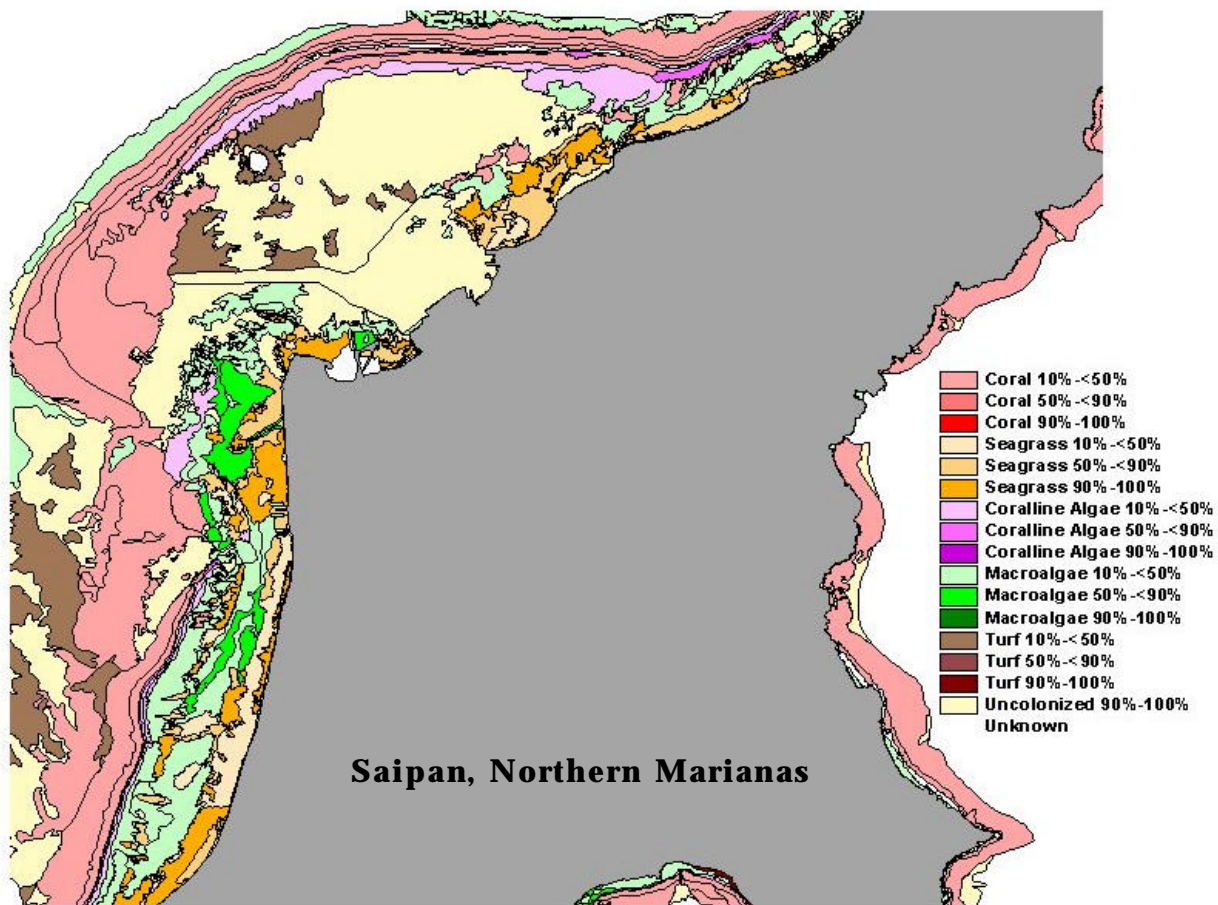
Mapping of the Northwestern Hawaiian Islands



Mapping of American Samoa



Mapping of the Northern Marianas



Key FY03 Mapping Accomplishments–Pacific Region

- **Conducted fish, towed diver, and acoustic survey of American Samoa coral reef ecosystems, the first in 17 years. NOAA partnered with the Government of American Samoa, the University of Hawaii, Oregon State University, FWS, and the Bishop Museum.**
- **Partnered with the University of Hawaii to conduct a 25-day multibeam and backscatter data gathering mission in the NWHI. The data are being processed in partnership with the University of Hawaii. Also began using the Acoustic Habitat Investigator launch equipped with a Reson 8101 (5–100 m) multibeam system.**
- **Completed maps of the shallow-water coral reef ecosystems of the NWHI.**
- **Completed maps of the shallow-water coral reef ecosystems for approximately 60 percent of the main Hawaiian Islands.**
- **Compiled the Bathymetric Atlas of the Northwestern Hawaiian Islands: A Planning Document for Benthic Habitat Mapping–Draft, which graphically summarizing the extent of multibeam and single-beam bathymetric data, LIDAR, and IKONOS-based estimated depth data for the area.**



Key FY03 Mapping Accomplishments–Pacific (continued)

- **Science and Technology International, Inc. (STI) of Hawaii has been working to remap the main Hawaiian Islands. Maps are to be completed within 24 months.**
- **ALH completed draft maps of American Samoa in July 2003 and draft maps of Saipan, Tinian, and Rota in October 2003. The maps will be reviewed by the local Coral Reef Advisory Group and will be finalized in early 2004.**
- **ALH is currently mapping Guam. Guam’s coral reef steering committee has approved a draft classification scheme and imagery is being purchased. Maps are expected in early 2004.**
- **ALH has collected field data for the northern islands of the Northern Marianas. Imagery is still being purchased for these islands. A draft habitat classification scheme has been reviewed and accepted by the local steering group. Maps are due by the end of 2004.**
- **NOAA released and NMFS has drafted an update to a plan to comprehensively map the shallow to moderate depth (20-200 fathoms) coral reef ecosystems in the NWHI and U.S.–affiliated Pacific Islands using ship-based or aircraft-based technologies.**



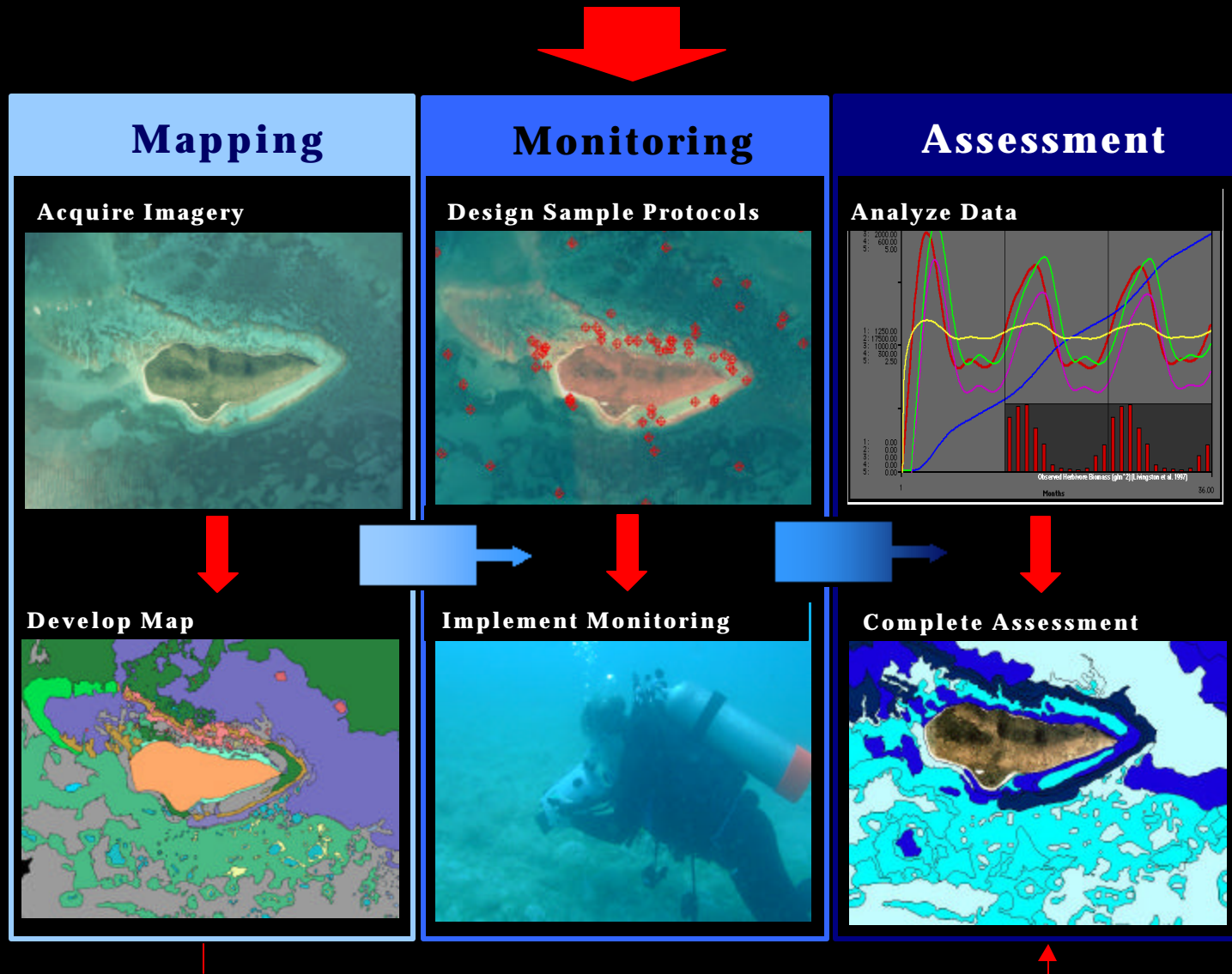
FY04 Proposed Activities and Projects in the U.S. Pacific

- **Continue mapping main Hawaiian Island shallow water coral reefs**
- **Complete American Samoa, Guam, and Northern Marianas shallow water coral reef maps**
- **Continue mapping shallow and deep water habitats throughout the U.S. Pacific using ship board and other technologies**
- **Continue to support data stewardship and processing efforts associated with habitat characterization and mapping**
- **Convene training workshops with local partners to demonstrate potential uses of and support the dissemination of benthic habitat map products.**



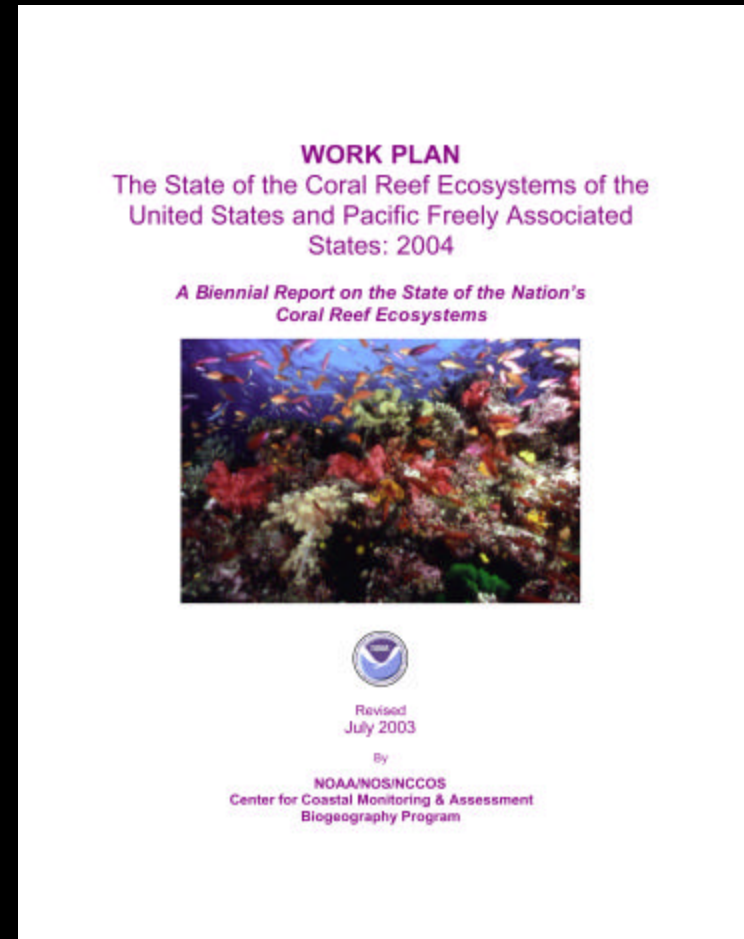
Integrative Mapping, Monitoring & Assessment

National Coral Reef Ecosystem Assessment Process



National Coral Reef Ecosystem Monitoring Program

- **Build a national database and information system for incorporating disparate data sets.**
- **Provide grants where needed to fill data gaps and sustain monitoring efforts.**
- **Integrate monitoring and habitat mapping to provide spatial framework for assessments.**
- **Produce the 2005 State of the US Reefs Report.**



National Coral Reef Ecosystem Monitoring Program

Cooperative Monitoring Studies to meet Local Management Needs and National Program Requirements

- 1) Provide leadership in the development and implementation of a national program to monitor US coral reef ecosystems.
- 2) Develop a “semi-coordinated” National network of monitoring sites,
- 3) Facilitate sharing of monitoring information among partners, and
- 4) Fill gaps in local monitoring coverage.

A coordinated coral reef ecosystem monitoring program provides a national assessment capability to track the status and trends of coral reef health, community structure, and condition of US coral reef ecosystems.



National Coral Reef Ecosystem Monitoring Program

Program Partners

- **Hawaii (main 8 and Northwestern Hawaiian Islands)**
- **American Samoa**
- **Guam**
- **Northern Marianas**
- **Freely Associated States**
- **State of Florida**
- **Puerto Rico**
- **U.S. Virgin Islands**
- **Florida Keys National Marine Sanctuary**
- **Flower Gardens National Marine Sanctuary**

NOAA Complementary Monitoring and Assessment Studies



National Coral Reef Ecosystem Monitoring Program

Monitoring Themes

Benthic Parameters



- Cover (live, dead, etc.)
- Abundance
- Condition
- Size class distribution
- Indicator species
- Diversity*

Water Quality Parameters



- Nutrients
- Suspended solids
- Chlorophyll
- Turbidity
- Temperature
- PAR

Fishery Parameters

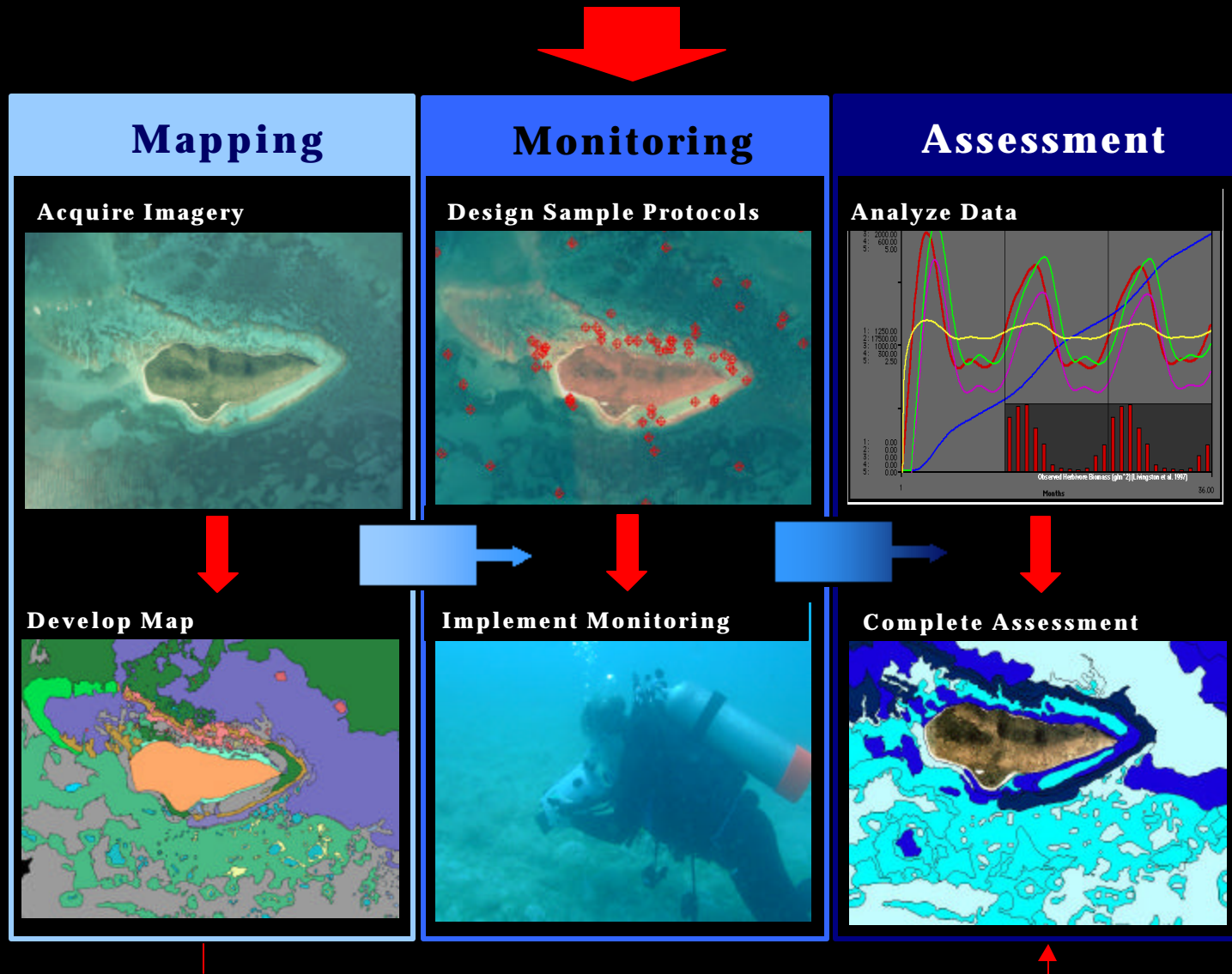


- Abundance & distribution
- Size class distribution
- Indicator species
- Diversity*
- Richness
- Evenness



Integrative Mapping, Monitoring & Assessment

National Coral Reef Ecosystem Assessment Process



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NOAA Coral Reef Mapping Program

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