

Benthic Habitat Mapping

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Coral Reef Ecosystem Program



NOAA Coral Reef Conservation Program

***CORAL REEF
MAPPING IMPLEMENTATION PLAN***

***MAPPING AND INFORMATION SYNTHESIS
WORKING GROUP of the
U.S. CORAL REEF TASK FORCE***



Rose Atoll - American Samoa

This document should be cited as:

Coral Reef Mapping Implementation Plan (2nd Draft), November 1999. U.S. Coral Reef Task Force, Mapping and Information Synthesis Working Group. Washington, DC: NOAA, NASA and USGS (Work Group Co-chairs). 17 pp.

**Goal #1:
Comprehensive
mapping of all
U.S. Coral Reef
Ecosystems**

NOAA Coral Reef Conservation Program

Mapping provides:

Fundamental spatial
framework

through...

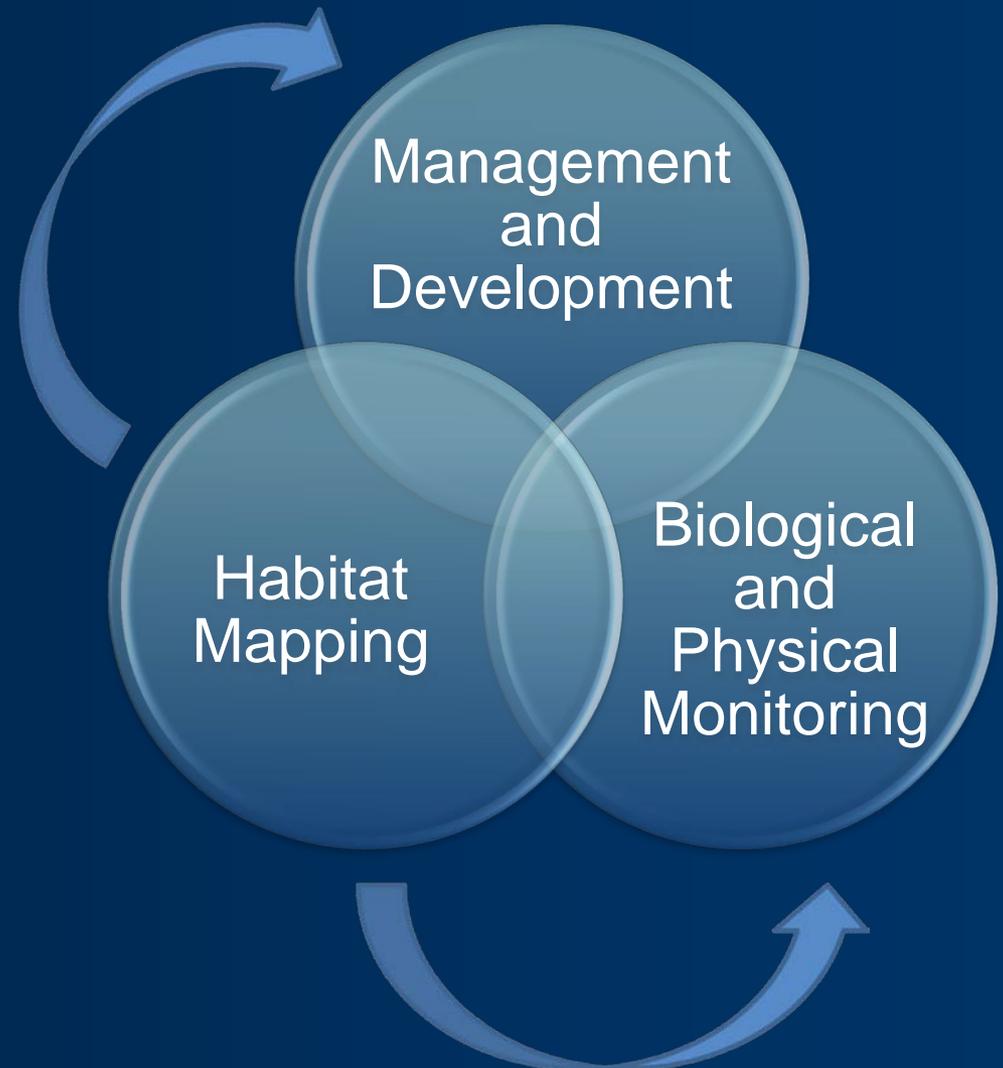
*Comprehensive and
consistent products*

so as to...

*Strategize monitoring
design*

and

*Inform management
decisions*



Baseline data and products

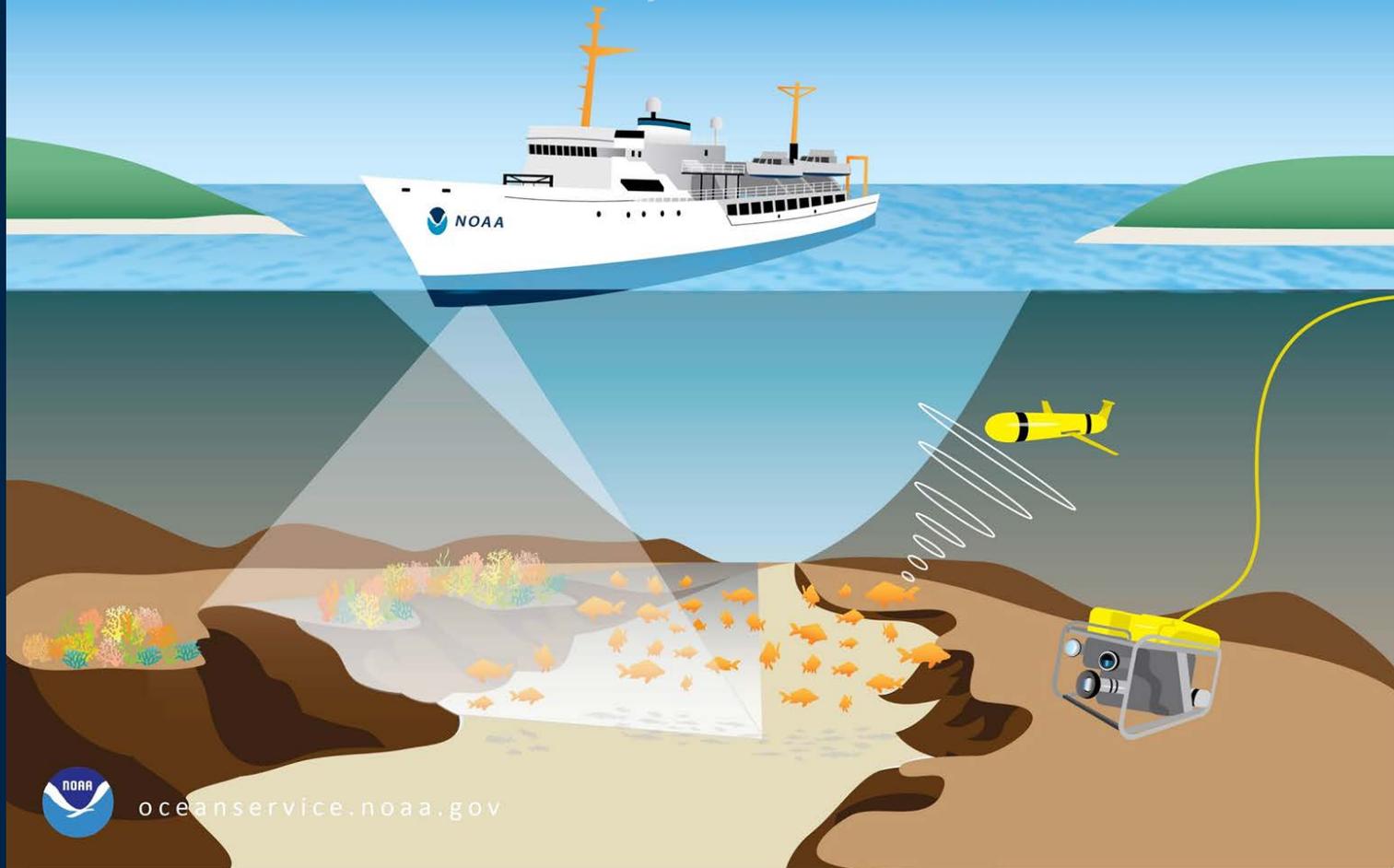


NOAA Coral Reef Conservation Program

How baseline data are collected: in-situ surveys

TOOLS OF THE TRADE

How NOAA Scientists Map What Lies Beneath the Waves

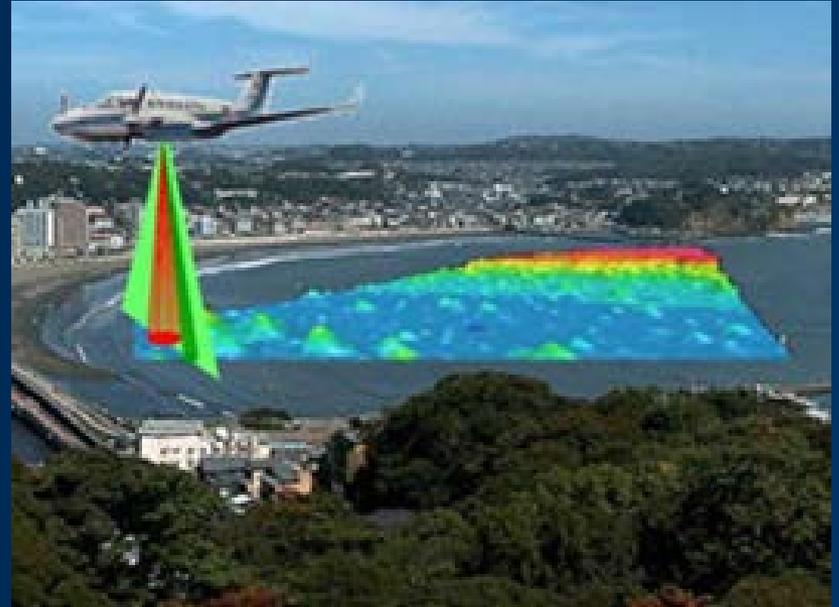


oceanservice.noaa.gov

C R C P

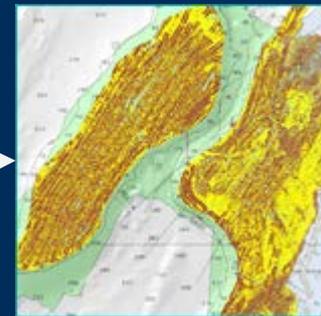
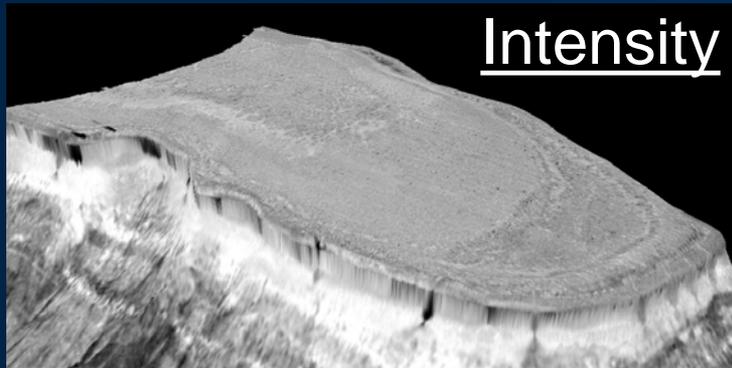
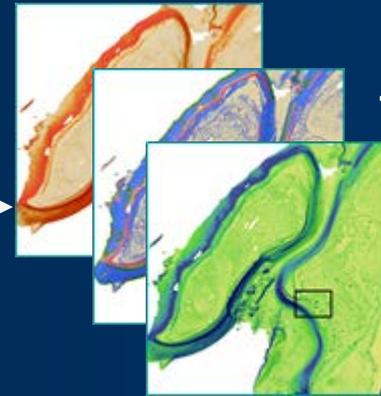
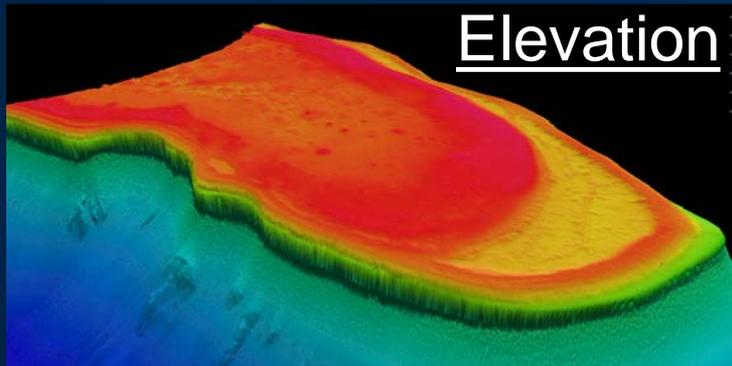
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How baseline data are collected: remote sensing



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Baseline data, products, and derivatives

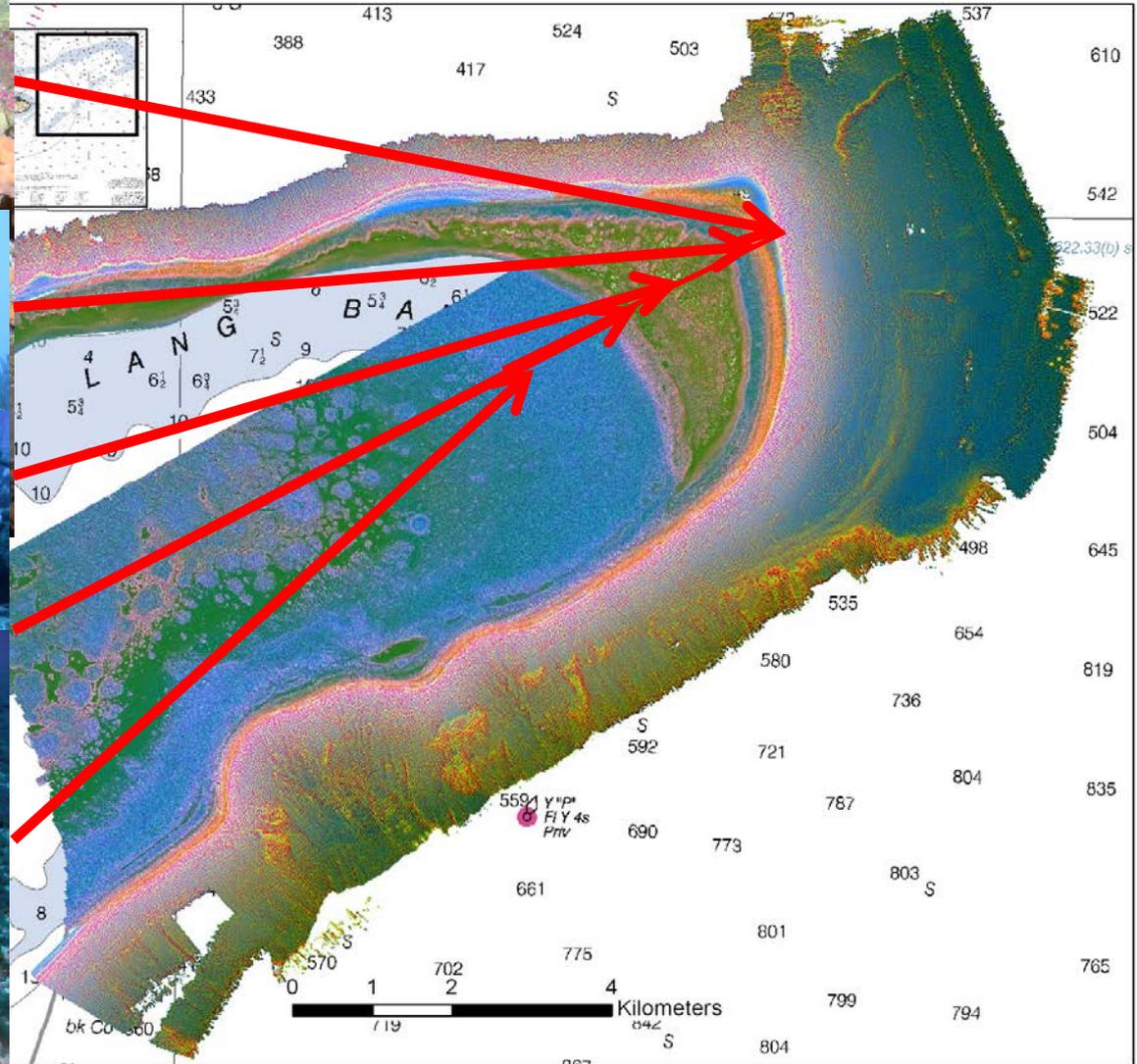
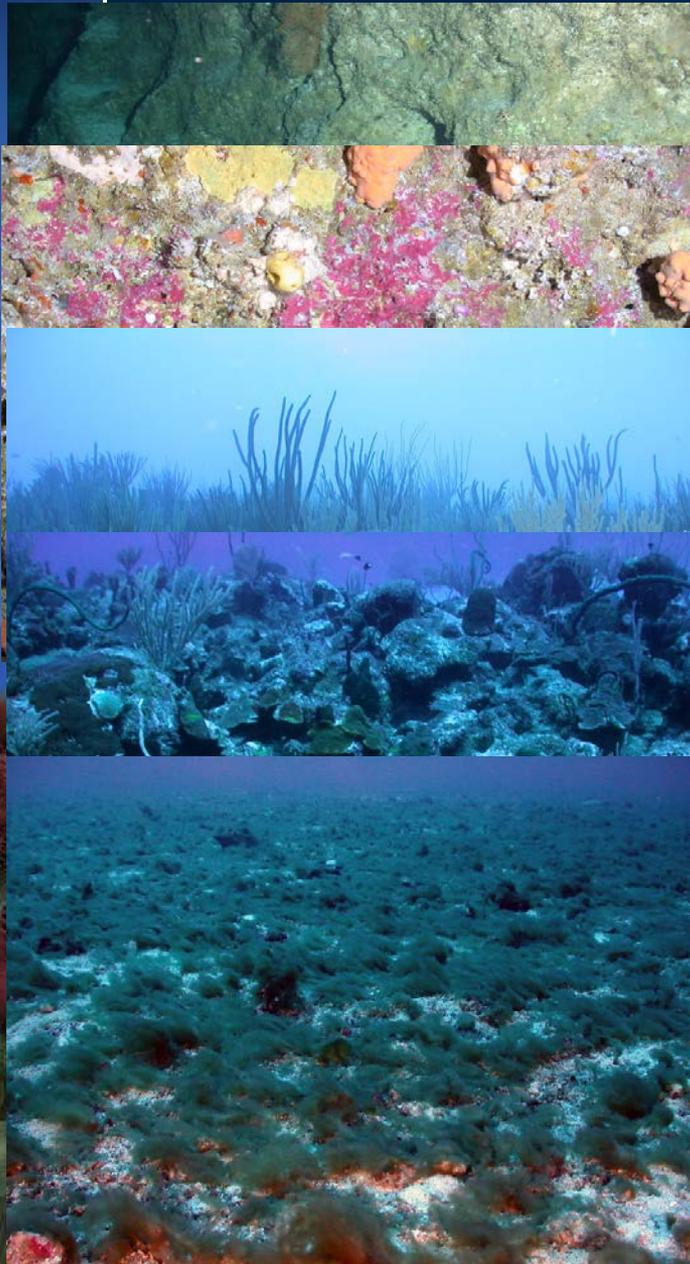


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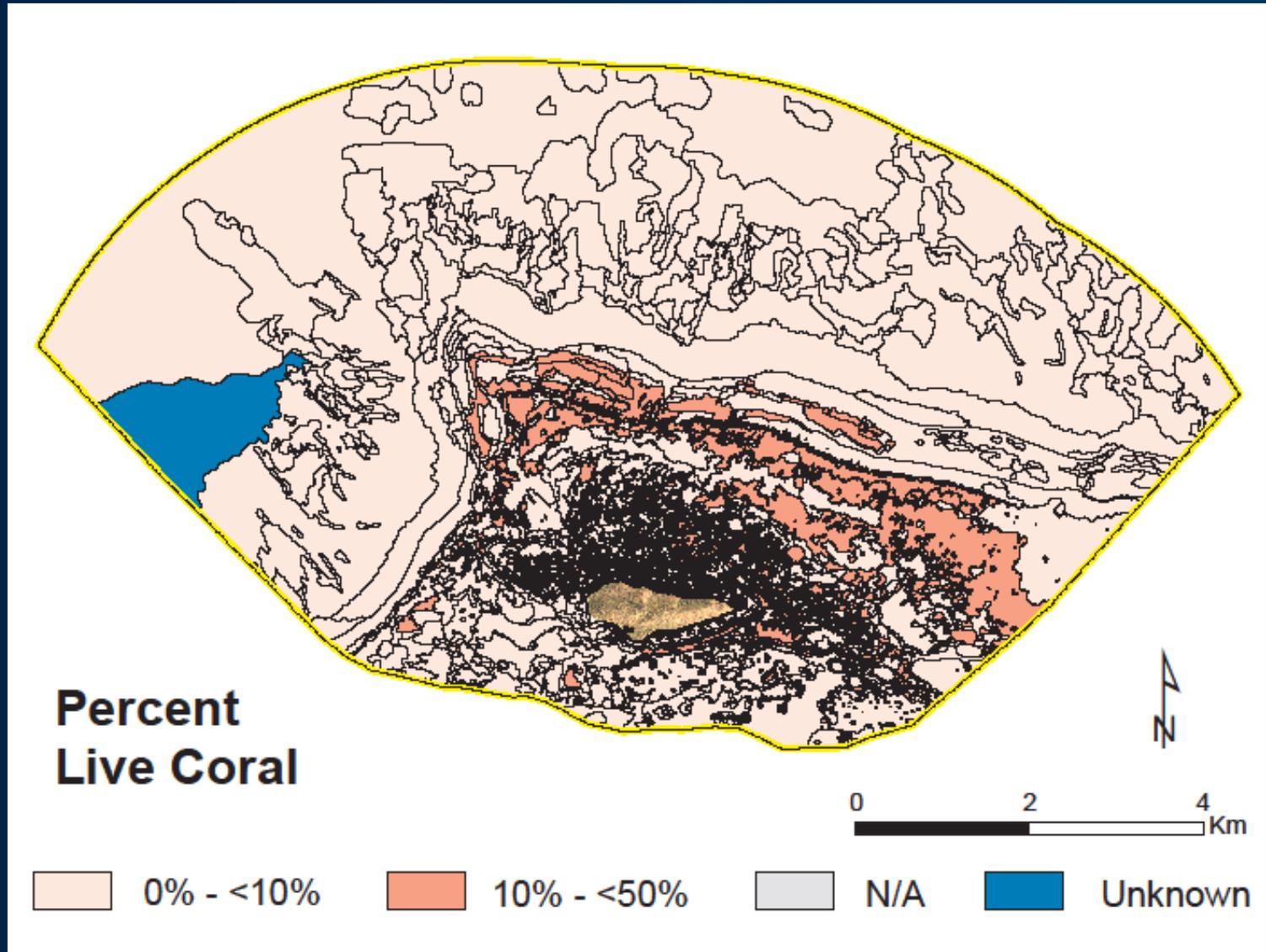
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Ground-truthing to Inform Map Making



NOAA Coral Reef Conservation Program

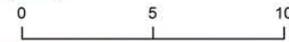
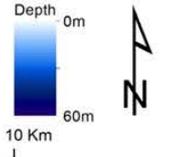
Synthesize data from different sources/methods



NOAA Coral Reef Conservation Program

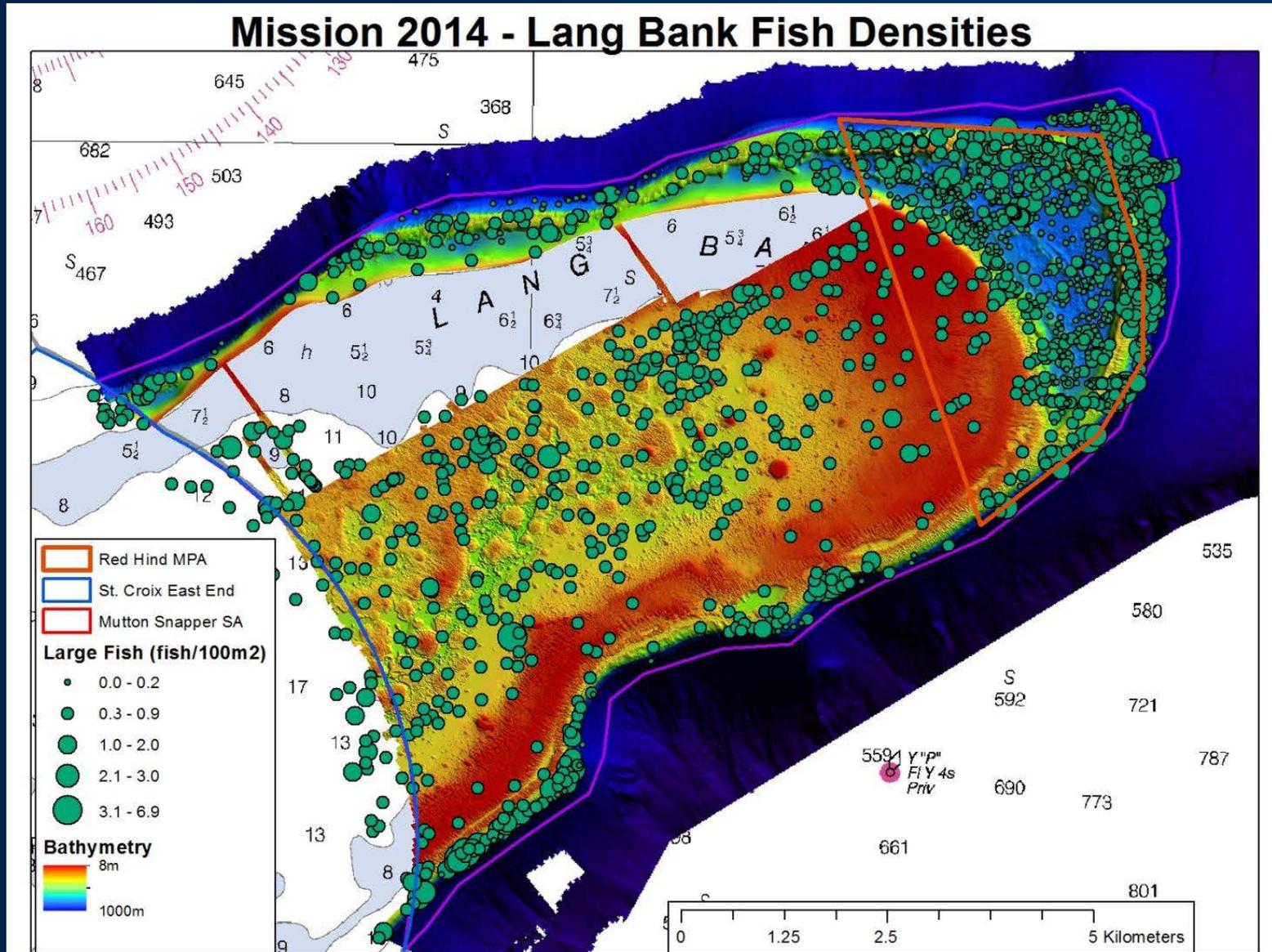
To create useful products: benthic habitat maps

Benthic Habitat: Biological Cover, Percent Cover



NOAA Coral Reef Conservation Program

To create useful products: Baseline Resource Distribution



Dissemination



NOAA Coral Reef Conservation Program

Data Visualization - Web-based Mapping Services

Northeast Reserve BIOMapper

Site 229 video

0:59 / 2:25

Play High Resolution

Results

Habitat Boundary Accuracy Assessment

45 features

Major Structure	Detailed Structure	% Hardbottom	Topographic Complexity	Ma Bic Co
Hardbottom				
Coral Reef and Hardbottom	Pavement	90% - 100%	Low	Alg
Coral Reef and Hardbottom	Pavement with Sand Channels	70% - <90%	Low	Alg

Data

- Detailed Geomorphological Structure
- Percent Hardbottom
- Topographic Complexity
- Biological Cover
 - Algae, Continuous (90% - 100%), Hardbottom
 - Algae, Patchy (50% - <90%), Hardbottom
 - Algae, Patchy (10% - <50%), Hardbottom
 - Algae, Continuous (90% - 100%), Softbottom
 - Algae, Patchy (50% - <90%), Softbottom
 - Algae, Patchy (10% - <50%), Softbottom
 - Live Coral, Patchy (50% - <90%)
 - Live Coral, Patchy (10% - <50%)
 - Mangrove, Continuous (90% - 100%)
 - Mangrove, Patchy (50% - <90%)
 - Mangrove, Patchy (10% - <50%)
 - Seagrass, Continuous (90% - 100%)
 - Seagrass, Patchy (50% - <90%)
 - Seagrass, Patchy (10% - <50%)
 - No Cover, Continuous (90% - 100%)
 - Unknown
- Percent Coral Cover
- Dominant Coral Type
- Dominant Coral Type & % Coral Cover
- Geographic Zone
- Additional Data
 - The Northeast Reserves
 - Reserva Natural Arrecifes de la Cordillera
 - Reserva Natural Cabezas de San Juan
 - Reserva Natural Canal de Luis Peña
 - Reserva Natural Corredor Ecológico del Noreste
 - Reserva Natural del Río Espíritu Santo
 - Accuracy Assessment
 - D Drop camera
 - S Snorkel
 - O Other
 - Ground Validation
 - Ground Validation Video Transect
- Additional Imagery
 - Hillshade Bathymetry
 - Multibeam Backscatter Mosaic 2012-2

Search

Change Background Map

NOAA Coral Reef Conservation Program

Direct Data Download

NCCOS Projects Explorer

Home About Us Our Research **Projects** Publications Products News Where We Work Funding Contact Us

You are here: Home / Research Projects / Project Details

Project Details

Seafloor Characterization of the U.S. Caribbean

Project Status: This project began in January 2004 and is Ongoing

Since 2004, we have been conducting seafloor mapping of the U.S. Caribbean, to fill gaps to support improved management measures in the U.S. Virgin Islands and Puerto Rico high priority sites identified by Jurisdictional managers. This project uses NOAA's seafloor mapping system to collect and provide detailed information about the depth, topography, and composition (approximately 5-1000m water depth) from which we can produce maps of benthic habitat.

Why We Care

The condition and extent of coral reef ecosystems and fish populations in the U.S. Caribbean are not well understood in many areas. The collection of these data by NCCOS has provided critical information for management decisions in areas ranging in depth from 5 to 1000m by filling data gaps. The spatial information beyond divable depths (30m) NOAA's Coral Health and Monitoring Program has limited the ability of resource managers to understand the condition and extent of coral reefs that gap.

What We Are Doing

In order to provide seafloor information to conserve Caribbean coral reef ecosystems, we use sensors, fish acoustic sensors, oceanographic sensors, LiDAR (light detection and ranging) to map and characterize the size and shape of physical habitats important for ecological patterns. Our activities target high priority sites identified by local and regional managers where information gaps exist, and, where the absence of sufficient biophysical modeling information has limited the evaluation of the effectiveness of potential management actions.

Our seafloor mapping of high priority sites using the NOAA Ship Nancy Foster and NOAA supported by NOAA's Coral Reef Conservation Program since 2004 and we have successfully mapped 3,000 km² in the U.S. Caribbean. Our efforts are focused on filling data gaps in management priority areas. In addition, our data and related products are used by others, including the Integrated Ocean and Coastal Mapping (IOCM) effort, "Map once, use many times."

Benefits of Our Work

The products outlined linked below will provide a critical spatial framework for informing an understanding of relationships in coastal coral reef ecosystems (5-1,000 m) within the U.S. Caribbean. Research has expressly identified the need for additional data in the coastal environment, which is especially important over large areas other than with ships and aircraft. The U.S. Virgin Islands and Puerto Rico have identified the need of seafloor mapping data for use in regulatory, management, infrastructure, assessment, and monitoring design applications. Specific instances include addressing is-

OUR RESEARCH PROJECTS

- Search all Projects

PIBHM Home

Organization

Benthic Habitat Mapping

DATA BY LOCATION

- Main Hawaiian Islands
- Northwest Hawaiian Islands
- CNMI-Guam
- Guam Island
- Apra Harbor
- Rota Island
- Tinian Island (& Aguijan Island, Tatsumi Bank)
- Anatahan Island
- Saipan Island (& Marpi Bank)
- Farallon de Medinilla
- Sarigan Island
- Guguan Island
- Alamagan Island
- Pagan Island
- Agrihan Island
- Asuncion Island
- Maug Island

CNMI-Guam: Guam Island

[Bathymetry | Backscatter | Optical Validation | Geomorphology]

Guam (Guahan in native Chamorro) is the southern-most island of the Mariana Archipelago and is located at 13 28' N, 144 47' E. It has a total area of 541.3 km² and the highest point is Mount Lamlam at 406 m. It had an estimated population of 173,456 in 2007. In 1950 under the Guam Organic Act, the island became an organized, unincorporated territory of the United States under the jurisdiction of the Office of Insular Affairs, Dept. of the Interior (DOI). Northern Guam is composed of flat, uplifted limestone, while the southern half is raised volcanic material. Over 10% of Guam's coastline has been set aside in five marine preserves, in an effort to combat declining reef health over the past 40 years. [more ...](#)

Click thumbnail maps below to explore PIBHM's data sets.

Bathymetry

Backscatter

Optical Validation

Geomorphology

Google Custom Search Search

Search our site.

Benthic Habitat Data

Bathymetry

Zipped data files contain 1) grid data file (GMT or ASCII), 2) high-res JPG of image, and 3) explanatory metadata text file (identical to linked file listed below).
* Ikonos imagery & USGS Digital Ortho Quarter Quads NOT included with download.

60m grid data

- View Metadata: Metadata text
- Zipped Data: Arc ASCII

Coverage Map

- View Metadata: Metadata text

Multibeam & Lidar Integrated Bathymetry

- View Metadata: Metadata text
- Zipped Data: Arc ASCII

5m grid data

- View Metadata: Metadata text
- Zipped Data: Arc ASCII

Backscatter Imagery

- AHI Reson 8101ER
- H'i'ialakal Simrad EM300

Optical Validation

NOAA Coral Reef Conservation Program

Education, Communication and Outreach: “Story Maps”



NOAA's National Ocean Service (NOS) and its partners have mapped almost 3 million acres—an area equivalent to 1.2 million football fields—of the nation's shallow-water (0-90 feet) coral reef ecosystems. The maps improve our understanding of these unique resources and support their study and protection.

Mapping America's Coral Reefs



Coral community in Nikko Bay. Dave Burdick

Coral Reef Bleaching Study

Scientists are sounding the alarm that [coral bleaching](#) and other heat-related stressors are likely to increase as ocean temperatures rise as a result of climate change. Scientists in Palau examined more than 30,000 coral colonies during a heat stress event in 2010 to study the nature of bleaching events and determine if certain habitats were resistant to thermal stress.

The NOS sea floor habitat maps were used to create a random sampling strategy that ensured divers targeted reefs across different habitat types, such as bays, patch reefs and outer reefs, throughout the study area. Data showed that cauliflower corals (*Pocillopora*) suffered the most bleaching and had the highest mortality rates. Scientists also found that bleaching in the bays, where water temperatures are normally higher on average, was low. This information will help managers identify locations that may serve as refuges for coral populations in Palau as the oceans continue to warm.

Legend

“We used the NOAA maps to help describe the sites that we were studying by showing what kind of habitats were there. If we did not have the map, I am not sure how we would design robust sampling scheme. The study would not have been possible without the maps.”

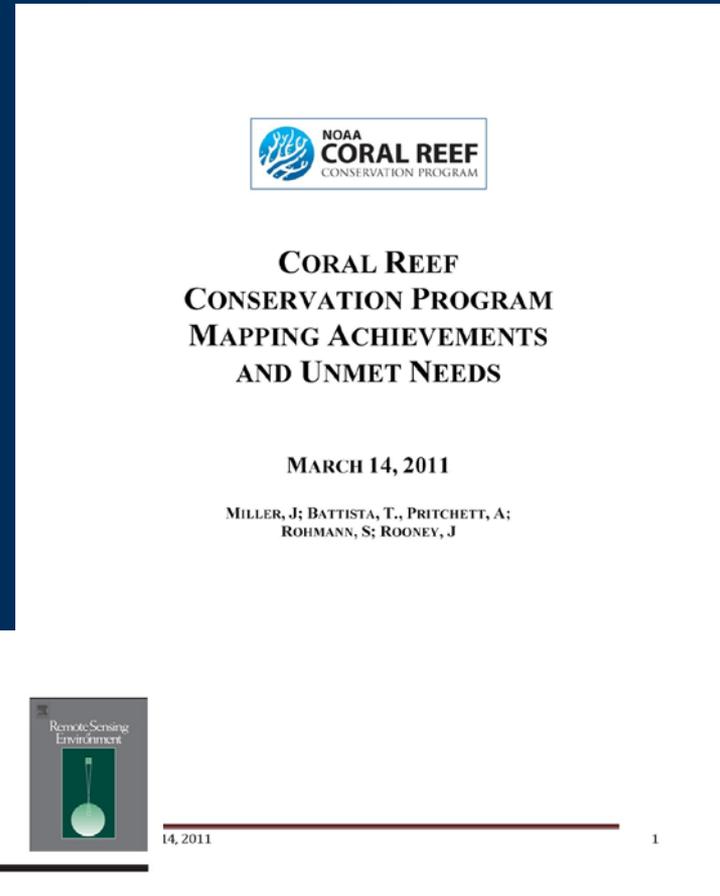
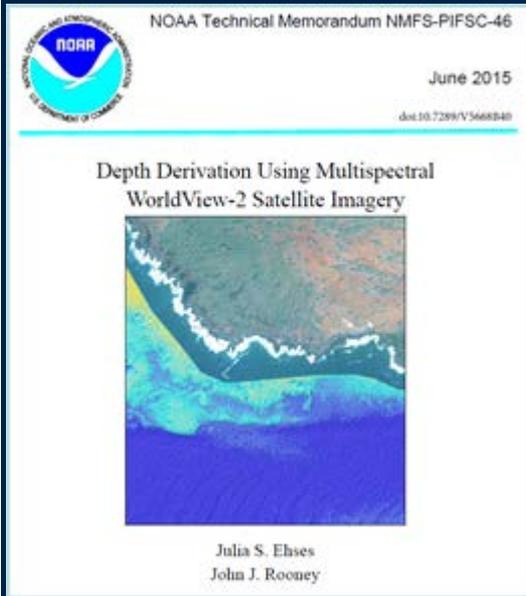
Yimnang Golbuu
Chief Researcher
Palau International Coral Reef Center

Angaur Airstrip
Peleliu Airport
Ngereulmud

10 nmi
30 km

NOAA Coral Reef Conservation Program

Methodology Development and Status Reports



Remote Sensing of Environment 113 (2009) 1082–1100

Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse



14, 2011

1

Comparative evaluation of airborne LiDAR and ship-based multibeam SoNAR bathymetry and intensity for mapping coral reef ecosystems

B.M. Costa ^{a,*}, T.A. Battista ^a, S.J. Pittman ^{a,b}

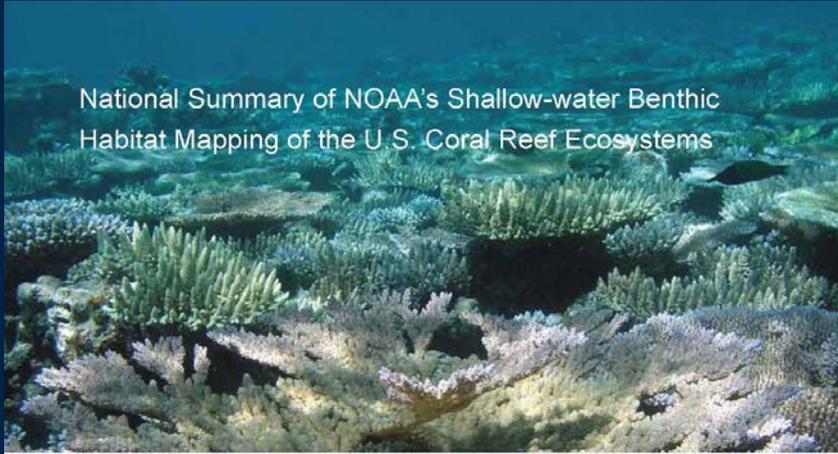
^a NOAA/NOS/CCMA Biogeography Branch, 1305 East-West Highway, Silver Spring, MD, 20910, United States

^b Marine Science Center, University of the Virgin Islands, 2 John Brewer's Bay, St. Thomas, VI 00802, US Virgin Islands

NOAA Coral Reef Conservation Program

Comprehensive Characterizations

National Summary of NOAA's Shallow-water Benthic
Habitat Mapping of the U.S. Coral Reef Ecosystems



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NOAA TECHNICAL MEMORANDUM NOS NCCOS 122



**coral reef ecosystem
monitoring report of the
mariana archipelago: 2003–2007**



Coral Reef Ecosystem Division
Pacific Islands Fisheries Science Center

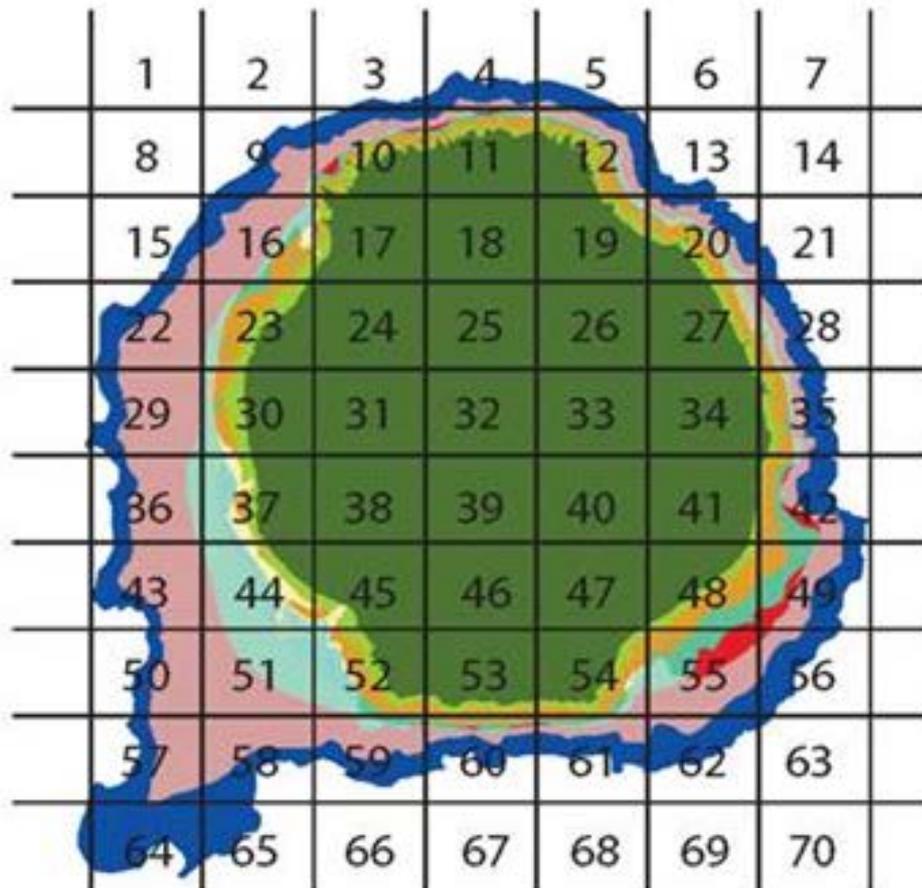
Mapping to Support...



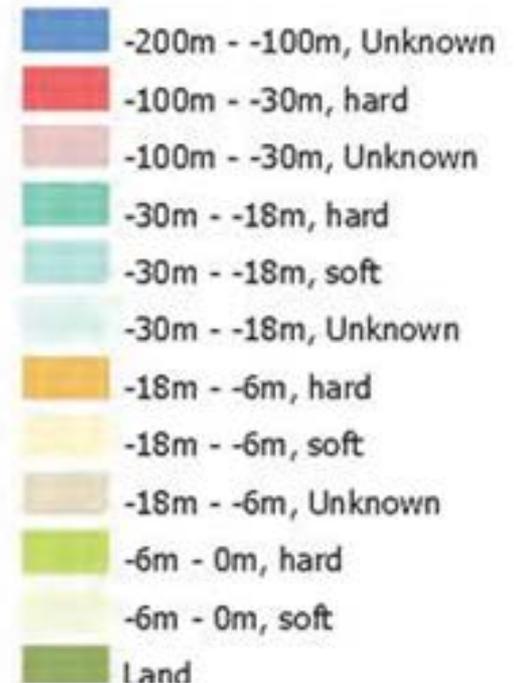
NOAA Coral Reef Conservation Program

Monitoring Coral Reef Ecosystems: NCRMP

Grid Cell System Joined With Depth And Habitat Information
Used For Stratified Random Sampling Design

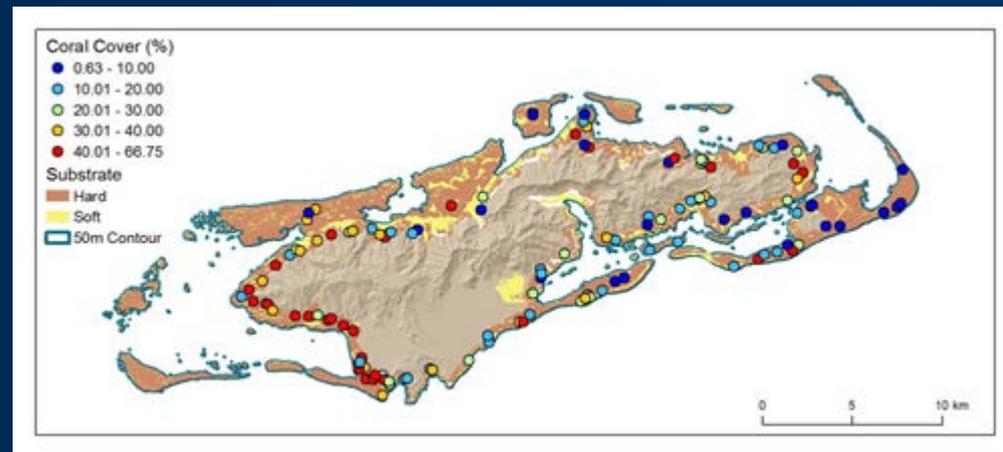
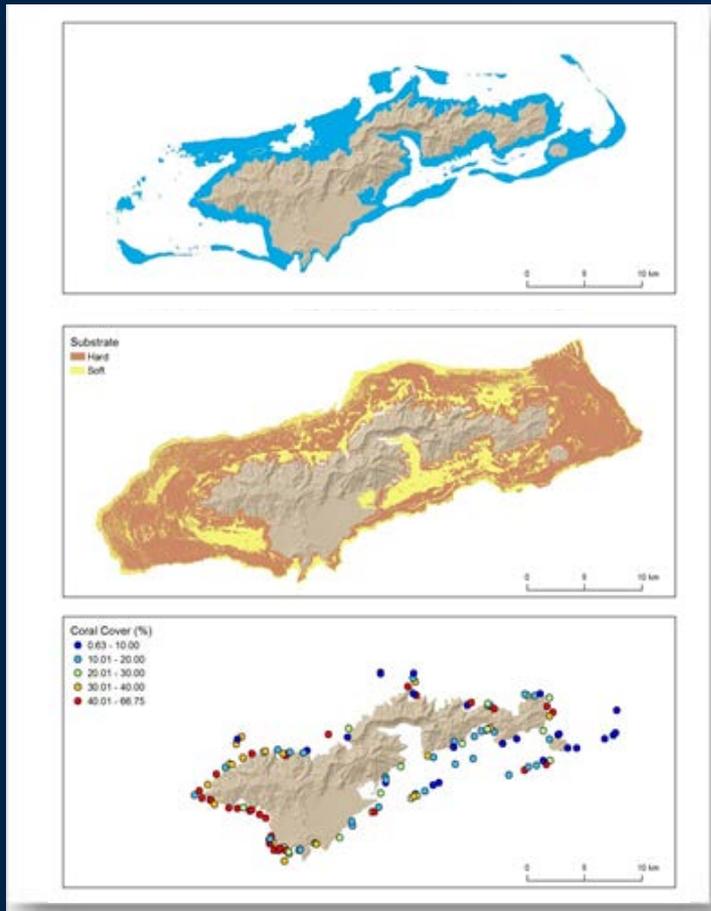


Depth Range (m), Bottom Type



NOAA Coral Reef Conservation Program

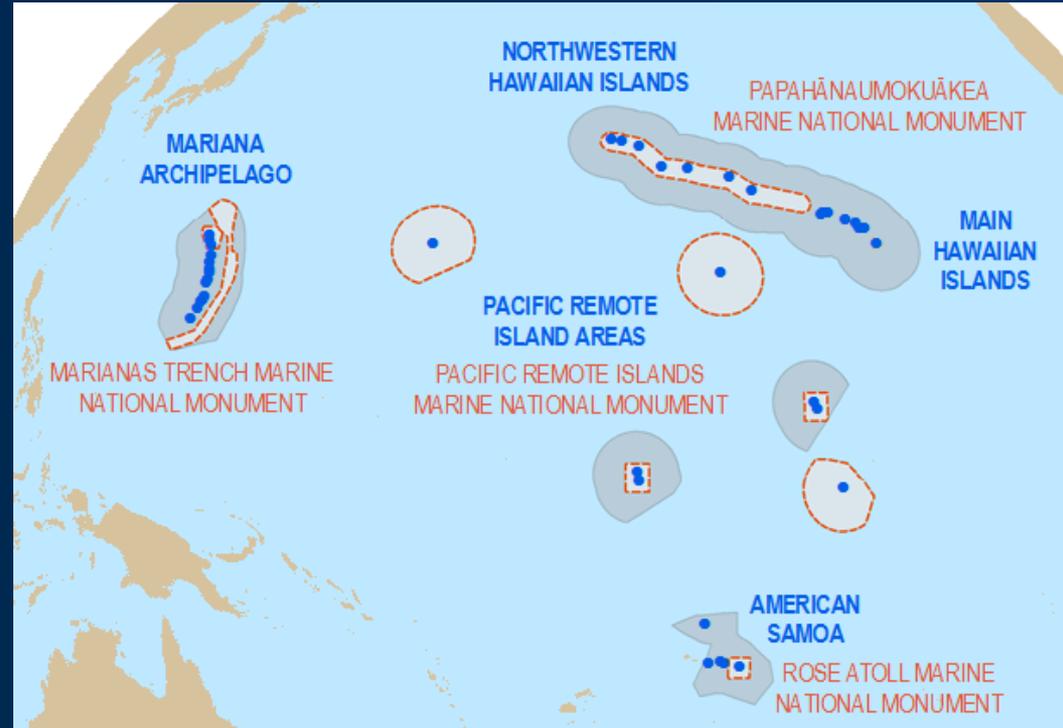
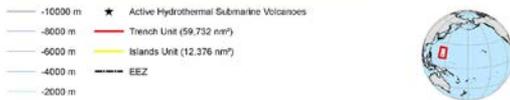
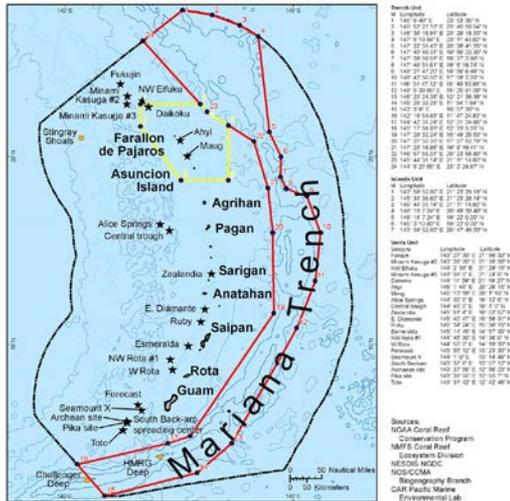
Federal Mandates: Endangered Species Act listed Corals



NOAA Coral Reef Conservation Program

Marine Protected Area (MPA) Designation

Marianas Trench Marine National Monument

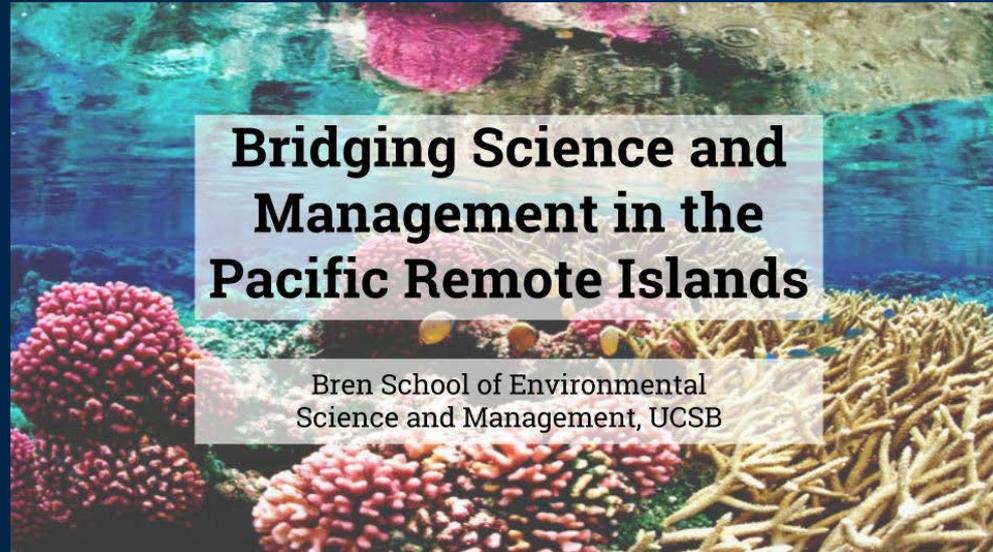


CRCP



NOAA Coral Reef Conservation Program

Management Plan Design: Pacific Remote Islands Marine National Monument Management Plan

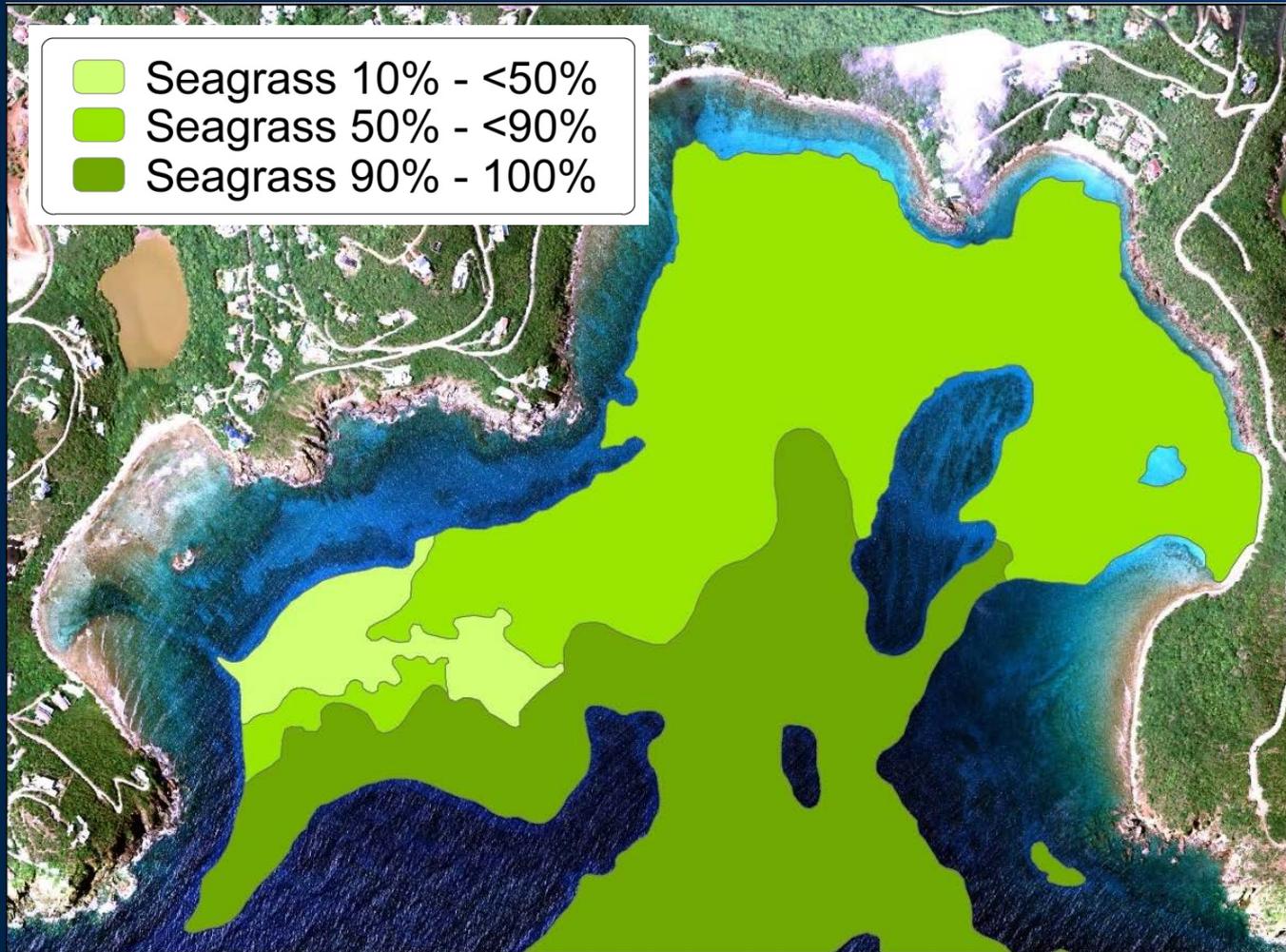


Pacific Remote Islands Marine National Monument Monitoring Report and Management Plan



NOAA Coral Reef Conservation Program

Monitoring Ecosystem Change to Evaluate Management Effectiveness



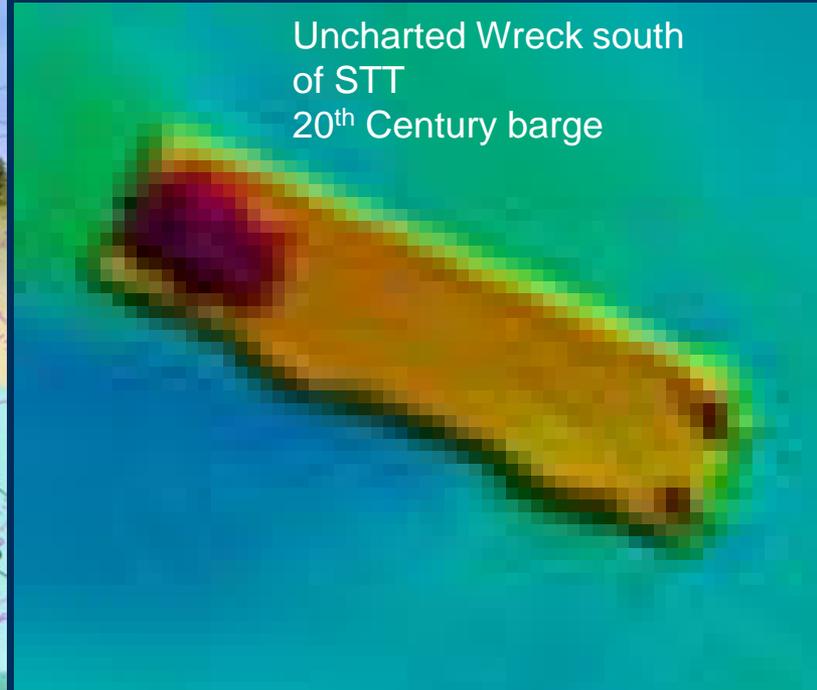
Rendezvous Bay, St. John (2009, 7400 m²)

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Other Applications: Safe Navigation, Cultural Resources

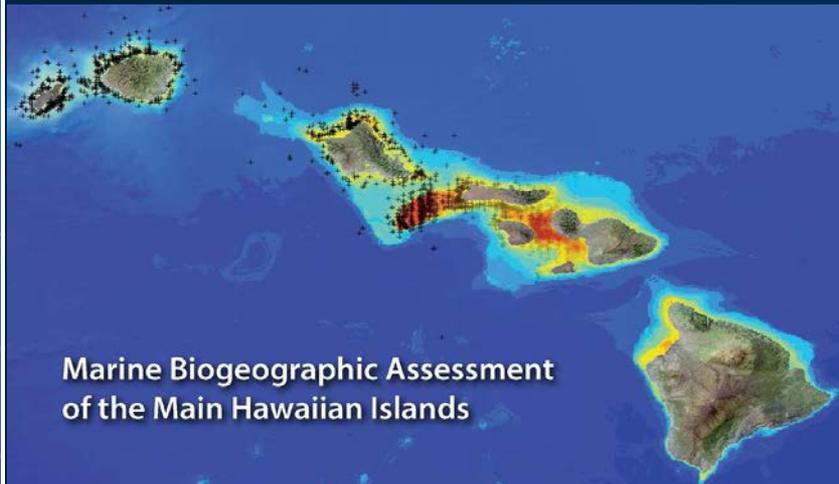


Uncharted Wreck south
of STT
20th Century barge



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Other Applications: Evaluating Infrastructure Development



Marine Biogeographic Assessment of the Main Hawaiian Islands



NOAA National Centers for Coastal Ocean Science
Center for Coastal Monitoring and Assessment

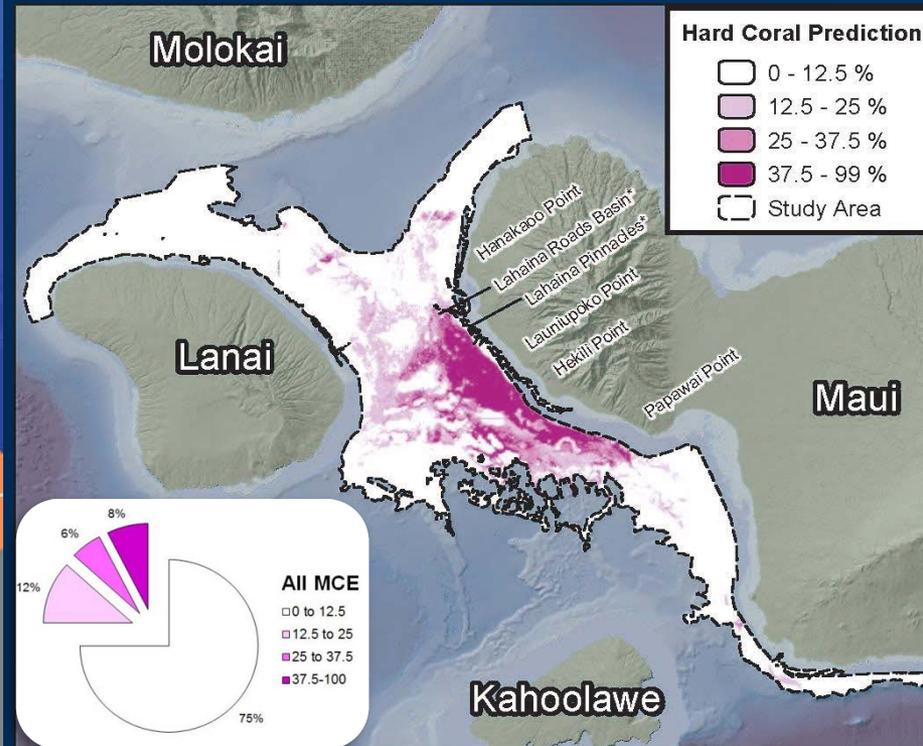
Editors
Bryan M. Costa
Matthew S. Kendall

July 2016

OCS Study BOEM 2016-035
NOAA Technical Memorandum NOS NCCOS 214




NOAA National Centers for Coastal Ocean Science

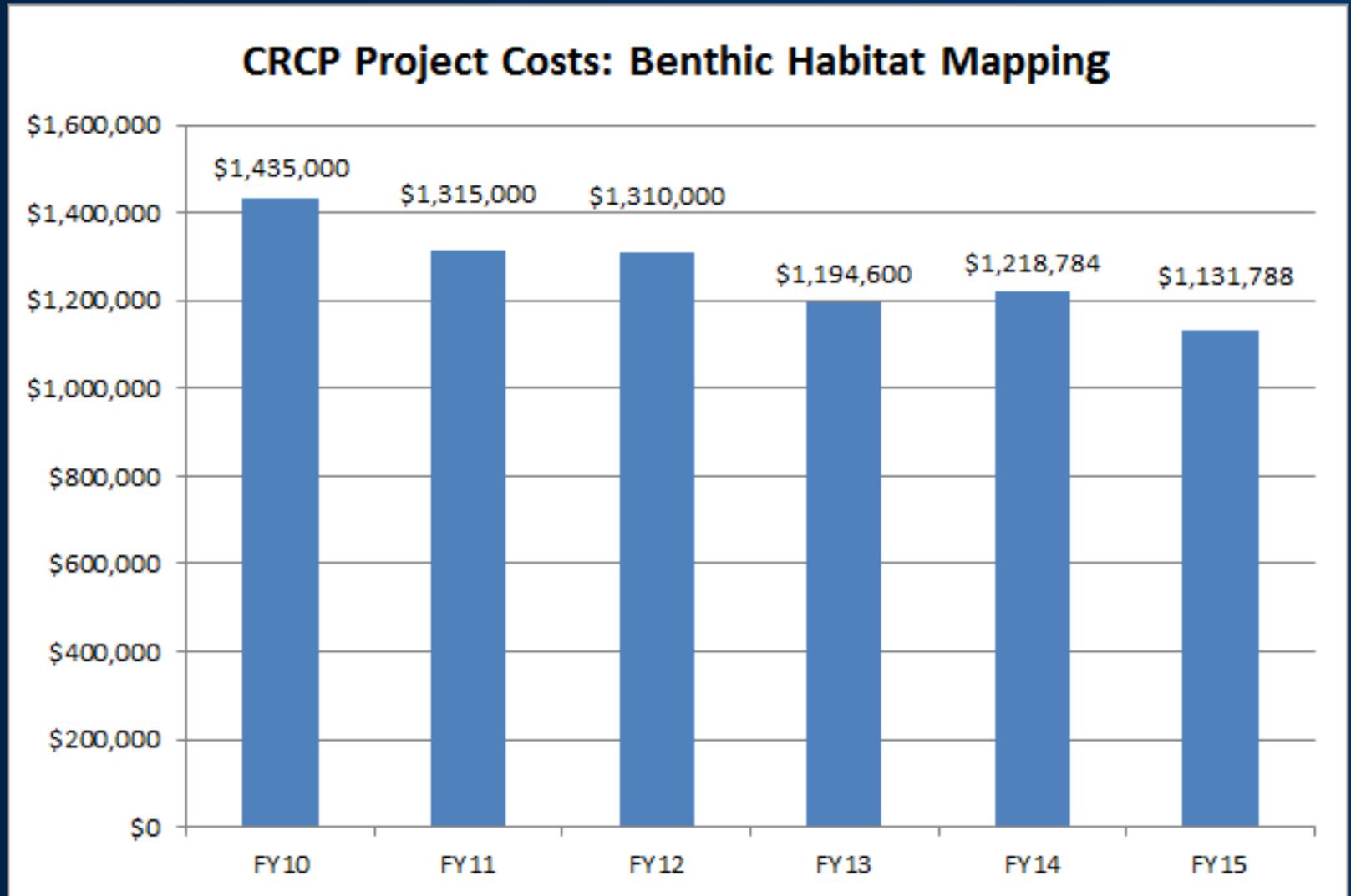


Current Status



NOAA Coral Reef Conservation Program

CRCP Mapping Funds FY10-15: **\$7,605,172**



NOAA Coral Reef Conservation Program

Leveraged Funding

- Direct:
 - Atlantic/Caribbean: \$2.5M
 - Pacific: >\$1.5M
- Indirect: \$15M
 - Ships and aircraft
 - Satellite collections
 - Ground-truthing
 - Personnel support



NOAA Coral Reef Conservation Program

Leveraged Partnerships

- **External:**

- Department of Defense: Navy
- National Geospatial-Intelligence Agency
- U.S. Geological Survey
- Bureau of Ocean Energy Management
- U.S Army Corps of Engineers
- U.S. Environmental Protection Agency
- USDA: Natural Resources Conservation Service
- Department of Interior: National Park Service
- NASA
- Academic Institutions in each Jurisdiction
- States, Territories and Commonwealths
- many NGOs...



NOAA Coral Reef Conservation Program

Leveraged Partnerships

Internal (NOAA):

- Office of Marine and Aviation Operations
- National Geodetic Survey
- Office of Coast Survey
- Office of Exploration and Research
- Center for Operational Oceanographic Products and Services
- Office for Coastal Management
- Office of National Marine Sanctuaries
- National Environmental Satellite, Data, and Information Service (NESDIS) – NCEI

*NOS and NMFS

Future Directions



NOAA Coral Reef Conservation Program

What's next?

- 5-year Master Plan
- Fill in the remaining data gaps
- Remap priority areas
- Test out new methods
- Integrated map products for entire reef habitat (0-150m)
- Data dissemination
- Integrated analyses
- Resurrect NOAA ship-based mapping

Challenges



NOAA Coral Reef Conservation Program

What is left to be mapped?

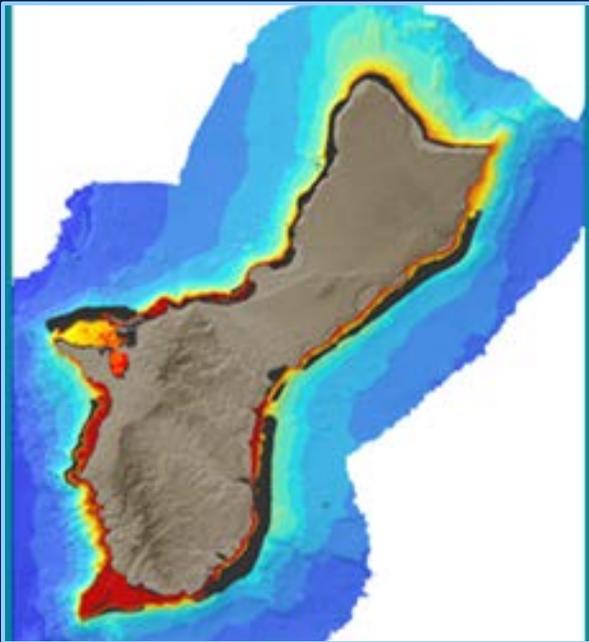
Bathymetry Coverage in the Pacific: 2000–2015

Depth	Tier 1			Tier 2	
	American Samoa	Marianas	MHI	NWHI	PRIA
0-30 m	59%	69%	66%	28%	68%
30-150 m	97%	87%	85%	54%	81%

NOAA Coral Reef Conservation Program

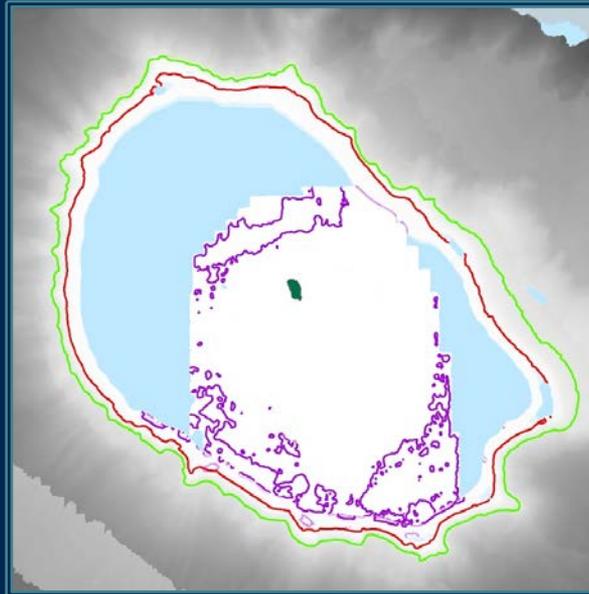
How to address the remaining gaps?

Guam



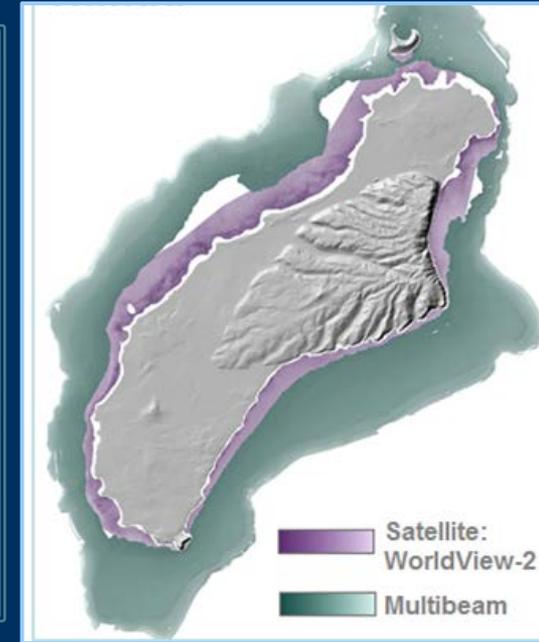
“Bath tub ring”

Lisianski



Inaccessible lagoons

Ni’ihau



“In between” gaps



NOAA Coral Reef Conservation Program

No "One Size Fits All" solution

Optical Imaging

Commercial Satellites

(0 – 30 m)

Multispectral

Pseudo-bathymetry

Bathymetric LiDAR

(0 – 70 m)

Bathymetry

Backscatter

Interferometric Sidescan

(1 – 30 m)

Bathymetry

Backscatter

Acoustical Imaging

Swath bathymetry

(10 – 1000 m)

Bathymetry

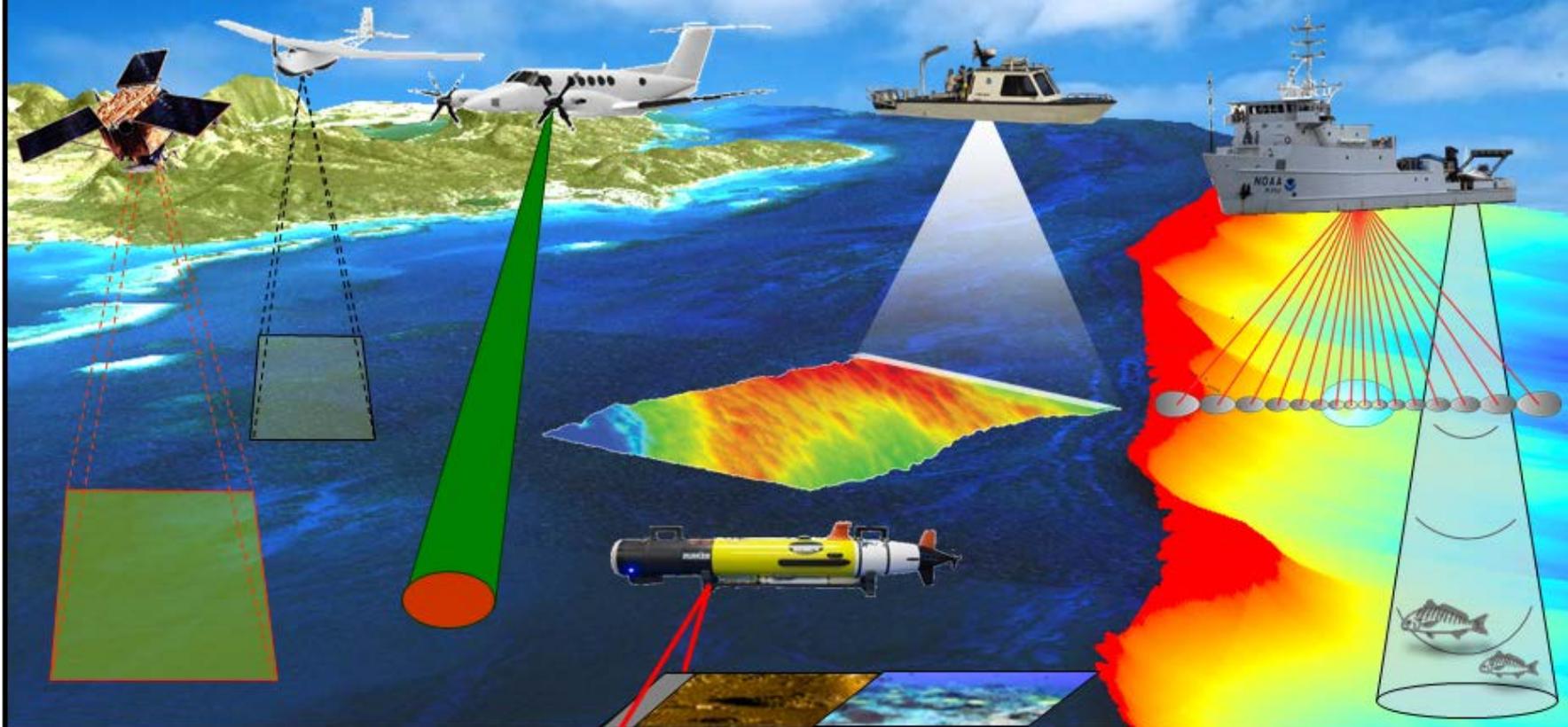
Backscatter

Fish Acoustics

(10 – 1000 m)

Bathymetry

Backscatter



C R C P

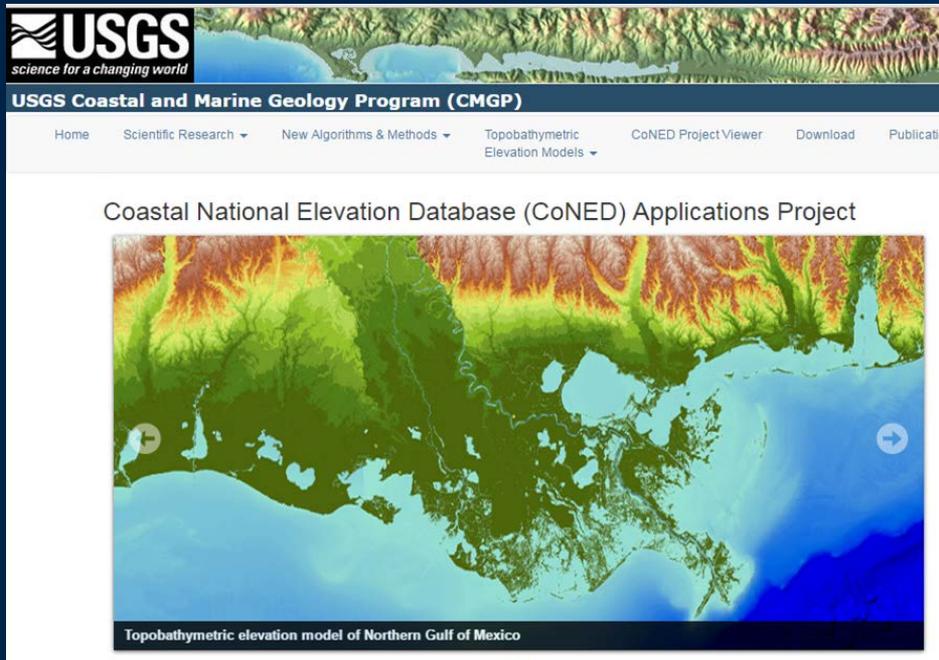
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Limited leverage opportunities



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Collaborations established from the ground up



What other challenges?

- Improve the process to capture Jurisdictional Priority Needs
- No archive options for video data
- Data organization and management



NOAA Coral Reef Conservation Program

THE END

NOAA
CRCP

