

**Project Title:**

CWT24-01 Updating the Florida Unified Reef Map in the Lower Florida Keys, the Marquesas, and the Dry Tortugas

**Project Dates:** 7/1/2023 – 12/31/2024

**Project Manager:** David Kochan

**Summary of Project Activity:** *\*3,500 characters*

The Florida Unified Reef Map (URM) is a geospatial data layer that provides a single, comprehensive view of benthic habitats of Florida's Coral Reef (FCR) and associated ecosystems across South Florida and the Florida Keys. The URM was created by merging individual maps provided by partners including counties, state and federal agencies, and universities. This data integration creates a seamless representation of FCR benthic habitats that serves as a valuable resource for researchers and managers. The importance of the URM to reef conservation is reflected by its use throughout many important reef-monitoring efforts, including FWC's Disturbance Response Monitoring (DRM), NOAA's National Coral Reef Monitoring Program (NCRMP), and the multi-agency Reef Fish Visual Census (RVC). Outreach efforts to these groups and others identified the need to expand the geographic extent of the URM and to improve the classification accuracy of certain habitat types.

The CWT24-01 project had three tasks: 1) expand the URM by integrating benthic habitat maps from newly mapped areas adjacent to the Dry Tortugas, 2) reclassify patch reef locations in the Lower Keys using new data to improve classification accuracy, and 3) conduct ground truth field work to support ongoing benthic habitat mapping efforts in the Marquesas.

Staff acquired the most up-to-date benthic imagery, LiDAR, and multibeam data of the FCR from NOAA's National Centers for Coastal Ocean Science (NCCOS). These geospatial layers included new classified habitat maps of the areas surrounding the Dry Tortugas and unclassified benthic data covering the Florida Keys and Marquesas. Staff also compiled survey data and photos from existing monitoring programs and collected new ground truth data through targeted field efforts and research cruises for ground truth data in the Lower Keys and Marquesas.

For task 1, staff integrated newly mapped habitats adjacent to the Dry Tortugas, covering the Tortugas Bank and Riley's Hump regions, into the existing URM. Expanding the habitat maps will allow reef monitoring programs to conduct surveys in these regions.

For task 2, staff delineated patch reefs in the new unclassified benthic imagery from the Lower Keys, which was identified as a priority region to update through outreach efforts.

Ground truth surveys were conducted in a subset of areas where the new patch reef layer disagreed with either the URM or the NCRMP grid. These field surveys and supplemental DRM surveys were used to determine where to update patch reefs in the URM. Unexpectedly, staff found that the existing URM matched ground-truth data better in most cases and required only a small number of changes to the patch reefs in the Lower Keys. For task 3, staff acquired survey data and imagery of benthic habitats in the Marquesas. In 2023 and 2024, habitat information and/or photos were collected at 38 sites on scientific research cruises. These data were combined with DRM survey data and photos to develop a ground truth geodatabase for future habitat classification of the Marquesas.

The integration of the Tortugas Bank and Riley's Hump habitats and reclassification of patch reefs in the Lower Keys were used to publish the Florida's Coral Reef Unified Reef Map v2.2, the first major update since 2017. The aggregated field and DRM survey data were combined into regional geodatabases to provide ground truth information for future habitat classification.

*Characters: 3142*

**Significant achievements, milestones, unexpected findings, issues or concerns:**

*\*3,500 characters*

The completion of this project resulted in the first major update to the Florida Unified Reef Map (version 2.2) since 2017, expanding the mapped habitats to cover the Tortugas Bank and Riley's Hump regions west and south of the Dry Tortugas. This effort added a total of 50,304 hectares of previously unmapped benthic habitat, which included 5,891 hectares of coral reef and 5,005 hectares of hardbottom. Expanding the URM to cover new areas was identified as the top priority during outreach with monitoring groups because many programs select survey locations based on the URM's mapped habitat types. As a result, monitoring programs like FWC's DRM and NOAA's NCRMP and RVC can now expand survey efforts in Tortugas Bank and Riley's Hump to provide critical data about Florida's most remote coral reefs.

This project also compiled a ground truth dataset of benthic photos, videos, and survey information across the Lower Keys and the Marquesas. Ground truth data helps calibrate habitat classification efforts by linking real world verification to benthic mapping. As new mapping data becomes available, like the FDEP's Florida Seafloor Mapping Initiative, accessible and organized ground truth data will allow for more rapid classification of habitat data. Further, field data can be used to train and validate automatic classification and machine learning models for more efficient habitat mapping.

The Lower Keys ground truth data were used to evaluate differences between the URM and a manually classified layer of patch reefs derived from new mapping data collected from 2018-2019. Outreach efforts with monitoring groups that utilize the URM revealed that patch reefs habitats in the Lower Keys were less reliable. Lower confidence in the area known as Hawk's Channel is not unexpected, as oceanographic processes cause consistently high turbidity that make LiDAR and satellite imagery difficult to collect. Indeed, FWRI has worked to improve the mapping data for patch reefs for the Lower Keys for many years, including with a project funded by CWT in 2007-2008. However, ground truth efforts showed that the URM outperformed the new mapping data in vast majority of cases. In fact, only 4 habitats previously classified as patch reefs in the URM were changed out of 38 field-validated sites. Further evaluation of terminated survey sites revealed that incorrectly labeled habitat was more often due to a mismatch in scale, as monitoring surveys use a 50x50m to 200x200m grid while patch reefs can be as small as 10x10m.

While staff were able to collect a large amount of field-verified ground truth data, there were several unavoidable issues that prohibited additional collection of more data. The first round of field work was planned for the fall of 2023, but a prolonged marine heatwave caused large-scale bleaching across Florida's Coral Reef. FWRI's response to the bleaching event occupied agency resources for several months, which resulted in the postponement of ground truth field work into summer and fall 2024. However, consistently challenging weather caused several cancellations of planned trips and limited the number of sites in the Lower Key and Marquesas that could be surveyed. Nevertheless, staff were able to supplement fieldwork with data collected by other groups, which allowed for the completion of each of the planned tasks.

**Characters: 3359**

**Summary of progress toward project goals/deliverables: \*3,500 characters**

Benthic maps in the URM (version 2.0) are largely limited to the 20-meter depth contour, leaving ecologically significant portions of coral reef habitat in the Florida Keys unmapped. To address this gap, NCCOS has produced seafloor maps of previously uncharted areas of Tortugas Bank and Riley's Hump adjacent to Dry Tortugas National Park. By compiling hydrographic multibeam sonar survey data collected from 2004 to 2018, NCCOS mapped more than 50,000 hectares of benthic habitat. Staff integrated this newly mapped data into the URM, expanding its geographic coverage of the Florida Keys. About 2% of the new maps from NCCOS overlapped with the existing URM, so staff used ancillary and ground truth data to resolve discrepancies within the overlap area. The ancillary data included multibeam bathymetry data collected by NOAA Ship Nancy Foster from the years 2004-2018 and processed by NOAA's Center for Coastal Fisheries and Habitat Research, as well

as the 3-band Principal Component Analysis layer of eight complexity surfaces produced from the multibeam bathymetry data collected by NCCOS. Sentinel satellite imagery acquired in May of 2024 was also used to reconcile differences in the integration process, ensuring a smooth transition between the seams of the two map products. Staff published all updates to the URM version 2.2 on FWC's ArcGIS Online organization and web servers.

Staff manually delineated patch reefs in the Lower Keys from high resolution (<1 meter) topobathy LiDAR data collected between 2018 and 2019 by NOAA's National Geodetic Survey Remote Sensing and the U.S. Army Corps of Engineers. Staff investigated the use of machine learning and artificial intelligence to classify the benthic habitats but ultimately found manual delineation was more accurate with the data provided for patch reefs across the Lower Keys. To guide field work and QA/QC ground truth efforts, staff identified coordinates in areas where either the URM patch reef layer disagreed with the manually delineated patch reefs in the Lower Keys or the NCRMP grid, a 50x50m grid that is used by multiple monitoring programs for their survey design. A total of 22 sites were surveyed in August of 2024 by divers to characterize benthic habitats and estimate vertical relief and coral cover. A survey to collect ground truth data in the field was designed in ArcGIS Field Maps and data collected was used to remove four patch reefs from the URM in the Lower Keys. DRM surveys conducted in 2024 in locations where the URM patch reef layer, the manually delineated patch reefs in the Lower Keys, or the NCRMP grid disagreed were also used to determine the accuracy of the patch reef layers. The results from the ground truth surveys were insufficient to conclude that the manually delineated patch reef layer in the Lower Keys should replace URM's patch reefs on the whole. Additionally, the manually delineated patch reef layer is 79 percent similar to URM's patch reef layer, and most other manually delineated patch reefs match hard bottom habitat in the URM.

Staff built a geodatabase with ground truth data including imagery of benthic habitats collected in August of 2024, DRM surveys conducted by partners, and photos and survey data from a Marquesas research cruise. This geodatabase was shared with NCCOS via FWC's GIS web services to inform ongoing benthic habitat mapping efforts in the Marquesas and Lower Keys.

**Characters: 3,420**

**Layman's project description \*3,500 characters**

**Please Briefly describe the goals and accomplishments of your project from inception to completion using layman's terms. This description will be provided to audiences who may not be professionals in our field. The Foundation may use this description in**

**public relations materials as well. Between one and three brief paragraphs should suffice.**

The Unified Reef Map (URM) provides a continuous and seamless representation of Florida's Coral Reef stretching from the Dry Tortugas to Martin County. Many management, academic, and industry stakeholders rely on the URM to conserve and manage Florida's Coral Reef. However, the map had not been updated since 2017. FWC staff located a new dataset of previously unmapped coral reef habitat adjacent to the Dry Tortugas National Park in the Tortugas Ecological Reserves, including regions of Tortugas Bank and Riley's Hump. This new dataset, produced by NOAA's National Centers for Coastal Ocean Science (NCCOS), was integrated into the URM to fill gaps between the Dry Tortugas National Park and Florida Keys National Marine Sanctuary boundaries. The new URM data layer was shared to Florida's Unified Reef Map page and can be downloaded by members of the public.

To improve the URM with the most up to date information, FWC Staff retrieved seafloor maps collected between 2011 and 2019 by NOAA's National Geodetic survey Remote Sensing Division and the U.S. Army Corps of Engineers and used these datasets to identify and manually outline patch reefs. Dive surveys conducted in August 2024 revealed that the manually delineated patch reef layer was not more accurate than the URM. However, using the ground truth surveys, FWC staff identified and removed four patch reefs on the URM that did not match the patch reef habitat type. Data and photos from these surveys, as well as underwater imagery collected in the Lower Keys during FWC's Disturbance Response Monitoring and another marine research cruise in the Marquesas, were all compiled in one file and shared with NCCOS. These datasets will help inform ongoing mapping efforts in Florida's Coral Reef.

Characters: 1756

## **File Uploads**

Overlap integration document

List of Links