

Users Guide to the Unified Florida Reef Tract Map

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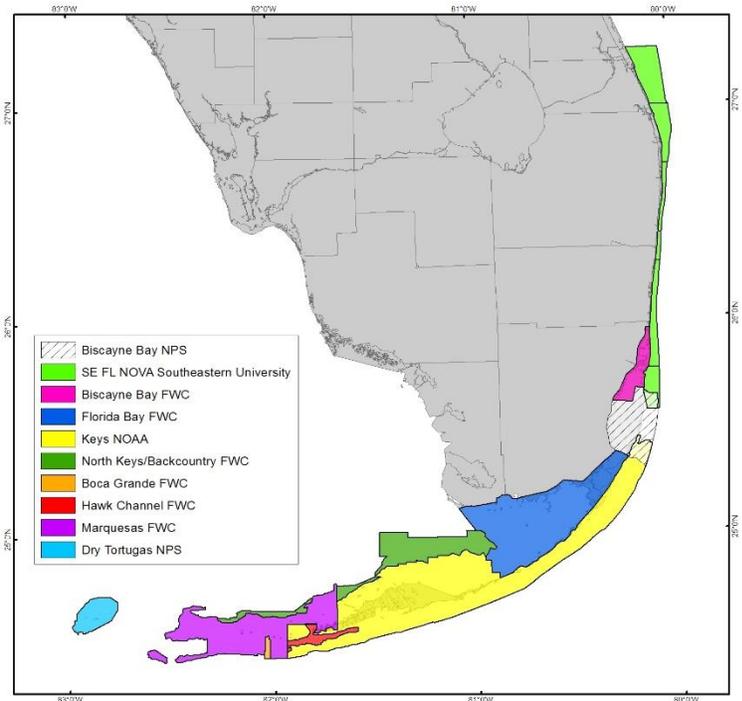
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➤ Introducing the Unified Florida Reef Tract Map

❖ What is the Unified Florida Reef Tract Map?

The Unified Florida Reef Tract Map (Unified Reef Map) provides a consistent geographic spatial framework for management, monitoring, and characterization of the Florida Reef Tract from Martin County to the Dry Tortugas. The map integrates existing benthic habitat maps of Martin, Palm Beach, Broward, and Miami counties, Biscayne National Park, Florida Bay, and the Florida Keys, including the Dry Tortugas. The map is publicly available through internet-based mapping tools accessible to desktop and laptop computers, tablets, and smartphones.



❖ Unified Class Levels

Through the mapping process, lines are drawn around different seafloor types and the dominant biological cover (such as live coral or seagrass) and geological formations (such as patch reef, sand or pavement) are described using categorical classification schemes. Classification schemes differ among mapping projects. Unified Class Levels (UC Levels) integrate the classification schemes into a common framework and provide flexibility in selecting the amount of benthic information detail needed. The amount of detail needed will be dictated by the research question or need. There are five levels of detail with UC Level 0 being the most general and UC Level 4 being the most detailed. Acting as a common denominator, the general UC Levels ensure consistency across the entire reef tract. The first 3 UC Levels are described in Table 1. Detailed information for benthic classification values can be found in this [NOAA technical report](#).

Unified Reef Map Level 1

- Individual or Aggregated Patch Reef
- Aggregate Reef
- Pavement
- Reef Rubble
- Scattered Coral/Rock
- Ridge
- Seagrass (Continuous)
- Seagrass (Discontinuous)
- Unconsolidated Sediment
- Artificial
- Dredged/Excavated

Table 1. Unified Classification Levels 0, 1 and 2.

Unified Class Level 0	Unified Class Level 1	Unified Class Level 2
Artificial	Artificial	Artificial
Coral Reef and Hardbottom	Aggregate Reef	Aggregate Reef
	Individual or Aggregated Patch Reef	Spur and Groove
		Individual or Aggregated Patch Reef
	Pavement	Pavement
		Colonized Pavement
		Pavement with Seagrass
		Pavement with Sand Channels
	Reef Rubble	Reef Rubble
Colonized Reef Rubble		
Reef Rubble with Seagrass		
Ridge	Ridge	
Dredged/Excavated	Dredged/Excavated	Dredged/Excavated
Seagrass	Seagrass (Continuous)	Seagrass (Continuous)
	Seagrass (Discontinuous)	Seagrass (Discontinuous)
Unconsolidated Sediment	Scattered Coral/Rock in Unconsolidated Sed	Scattered Coral/Rock in Unconsolidated Sed
	Unconsolidated Sediment	Tidal Flats
		Unconsolidated Sediment

❖ Spatial Integration

The Unified Reef Map is composed of information from different source maps that vary categorically or spatially. There are often discrepancies at the seams and where maps overlap. Interpretations of habitat types and boundaries may differ based on data sources used, methods (particularly mapping scale), and the interpreters themselves. In order to integrate the maps, **overlap is removed and boundaries are edited to match at the seams**. Individual maps that are assigned UC Levels but retain the original spatial information are also available online.

❖ Zones and Regions

Coral reef environments have distinct **Zones** (Figure 1) created by differences in depth, morphology, wave and current energy, temperature, and light. At a larger spatial scale, reef environments also differ based on their general geographic location - their **Region** (Figure 2). A benthic classification type may have distinctly different ecological communities based on the Zone and/or Region in which it occurs. For example, Spur and Groove has different ecological characteristics depending on its location in Lagoon, Reef Crest or Fore Reef Zones. Zone and

Region should be considered when evaluating benthic classification in ecological terms.

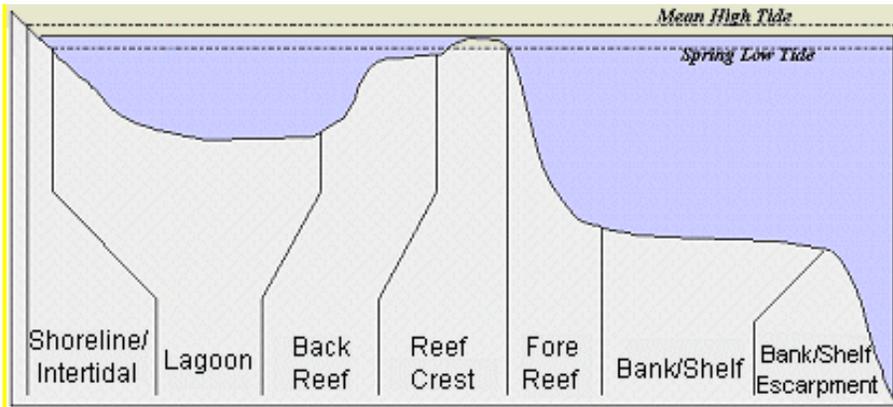


Figure 1. Coral Reef Zones (Graphic courtesy of NOAA NCCOS)

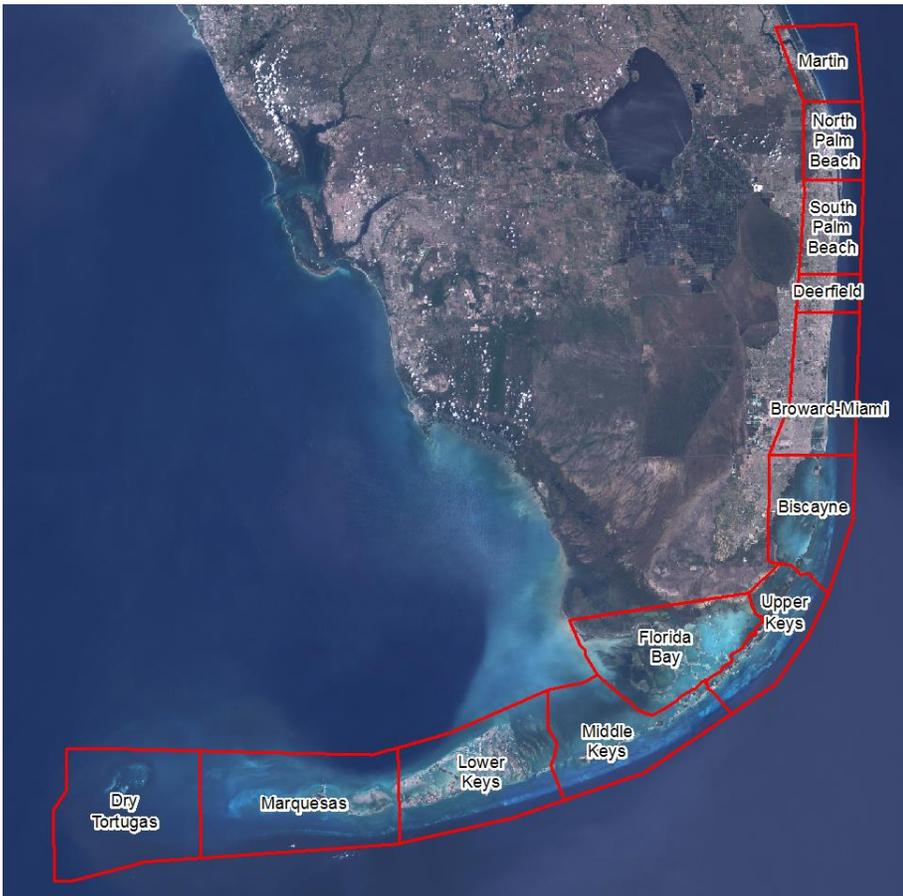


Figure 2. Florida Reef Tract Regions

➤ How to Access the Unified Reef Map

❖ Unified Reef Map website

<http://ocean.floridamarine.org/IntegratedReefMap/UnifiedReefTract.htm>

The URM website is the primary portal for accessing information and data related to the Unified Reef Map. The URM website contains links to web maps, downloadable GIS data, additional information about the project, and links to our data providers and project partners.



❖ Web Mapping Applications

Web mapping applications allow users to easily view and work with GIS data within an internet browser (i.e., Microsoft Internet Explorer or Google Chrome) without needing special skills or software. Web mapping applications also contain other monitoring and mapping data that are related to the URM. There are two URM web applications, both of which contain the same data but have slightly different tools and functions:

➤ FWRI's Unified Reef Map Web Application:

<http://ocean.floridamarine.org/IntegratedReefMap/webappbuilder/>

➤ ArcGIS Online Unified Reef Map:

<http://arcg.is/2hdFeyp>

❖ Mobile Mapping Applications

Web-mapping applications can also be used with mobile devices, such as smartphones or tablets. Simply download and install the free ArcGIS application from your device's application store and load the Unified Reef Map by searching the key phrase "FWC Unified Reef Map" at <http://www.arcgis.com/home/gallery.html>. This Web map will also provide access to additional spatial datasets related to South Florida marine resources.

❖ Downloadable GIS Data

GIS files and associated documentation can be downloaded from FWC's OpenData portal: <http://geodata.myfwc.com/>. The data download link is also available on the URM website. The GIS download package will contain the following:

 MetadataSourceBenthicMaps: contains metadata files (html) for the individual source maps that were used to create the Unified Reef Map. Metadata contains details on mapping methods, when the data were created and by who.

 CMECS Crosswalk Codes: This Excel spreadsheet contains information on how to translate the URM's Unified Classes (UC) into NOAA's Coastal and Marine Ecological Classification Standard (CMECS).

 Link to the Unified Reef Map website: Shortcut link back to the Unified Reef Map website: <http://ocean.floridamarine.org/IntegratedReefMap/UnifiedReefTract.htm>

 MetadataUnifiedFloridaCoralReefMap: Metadata file (html) for the Unified Reef Map. Metadata contains details on how the URM was created and also information on the individual source maps, where they came from, when they produced, and how they were made.

 UnifiedReefMap_vX: The URM GIS data are saved in an ArcGIS Layer Package file (.lpk). A Layer Package contains multiple map layers as well as layer properties and symbology.

 UsersGuideUnifiedFloridaReefTractMapVersion2.pdf: This User Guide will also be included in your download package.

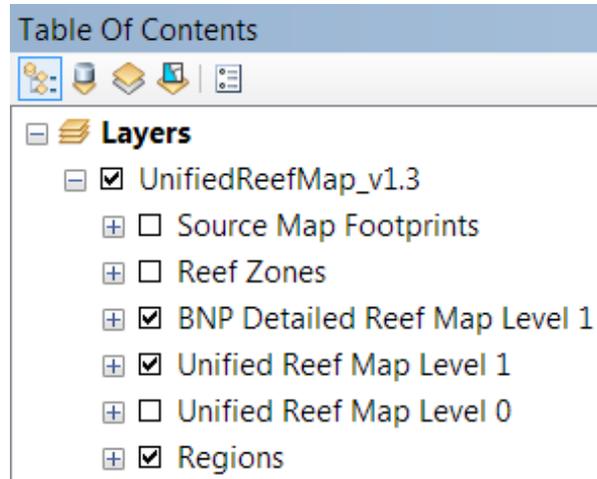
❖ Using the Unified Reef Map with ArcGIS

For ArcGIS users there are two ways to use URM data in your map:

Unified Reef Map Layer Package (.lpk):

The Layer Package file (.lpk) is similar to a zipped folder and contains GIS data saved in a geodatabase (.gdb) as well as layer properties and symbology. The geodatabase contains layers shown in the picture to the right.

Source Map Footprints: This layer shows the boundaries for individual map sources which were integrated into the Unified Reef Map.



BNP Detailed Reef Map Level 1: this is included as a separate layer in the geodatabase because portions of the layer were clipped from the Unified Reef Map where there was overlap with a neighboring map.

Unified Reef Map Level 1 & Level 0: These Levels refer to the Unified Classes used to represent benthic habitats in the Unified Reef Map. Each level contains different levels of habitat detail, Level 0 is the broadest category, and Level 4 is the most detailed.

To open the Layer Package: double click the .lpk file from Windows Explorer. If you have ArcMap project open, the ArcGIS file handler will add it to your map. Otherwise, the file handler will open the Layer Package in a new ArcMap session.

****By default, when a Layer Package is opened it will unpack the geodatabase onto your computer's harddrive here: C:\Users\\Documents\ArcGIS\Packages**

ArcGIS Web Mapping Services (WMS):

FWC hosts several Web Mapping Services which allow ArcGIS users to access data over the internet from our ArcGIS servers.

[Unified Reef Map Web Mapping Service](#)

[Ancillary Data for the Unified Reef Map Web Mapping Service](#)

[Tutorial for accessing Web Mapping Services](#)

➤ How to use the Unified Reef Map

❖ What kinds of questions can this map address?

Being a geospatial dataset, the Unified Reef Map can be used to **quantify spatial information**. The area, perimeter and length of features can be calculated and statistics can be calculated based on the spatial orientation of features. The Unified Reef Map is also a visualization tool for examining spatial patterns and exploring distributions of habitat features in relation to other environmental data that are included in the map.

❖ Map Limitations

- Maps are **not perfect**. They are abstract representations of reality. The Unified Reef Map is not an exception!
- There **may be errors** in the map. While research staff work hard to ensure high accuracy, not every single point on the map can be verified.
- There are **gaps** in the map. The absence of information for a location does not mean there is nothing of value in that area. Research staff are actively working to fill in gaps wherever possible.
- Some seafloor features **change over time**. The density and distribution of seagrass, for example, can change within a few years' time. Some areas in the Unified Reef Map were mapped several years ago from older, often coarser resolution imagery.
- Small features may not be represented in the map. For the most part, the smallest mapped feature is 1 acre, with the exception of patch reefs which are mapped to a much finer scale (150m²).
- Biscayne National Park and Dry Tortugas National Park are mapped at a finer scale than the rest of the Florida Reef Tract. These **scale differences** should be considered when conducting tract wide analysis.

❖ When not to use the Unified Reef Map

Map limitations must be considered when evaluating the Unified Reef Map. If, for example, one were to ask what species of seagrass or hard coral were present at a vessel grounding location, the Unified Reef Map would not be appropriate as it does not detail species type. While monitoring data is available at some locations with species specific information, a field survey would be necessary to identify species distribution in a specific area. Example scenarios for proper use of the Unified Reef Map are provided below.

❖ Example scenarios

Hypothetical Example Scenario #1: Consider a **coarse scale question** such as: What are the total areas for mapped hardbottom and seagrass in South Florida? If seagrass density distinctions are not necessary, the UC Level 0 would be most appropriate for consistently representing the entire Florida Reef Tract since seagrass density is not mapped for all parts of the Florida Reef Tract. Figure 3 illustrates the differences between UC Level 0 and 1.

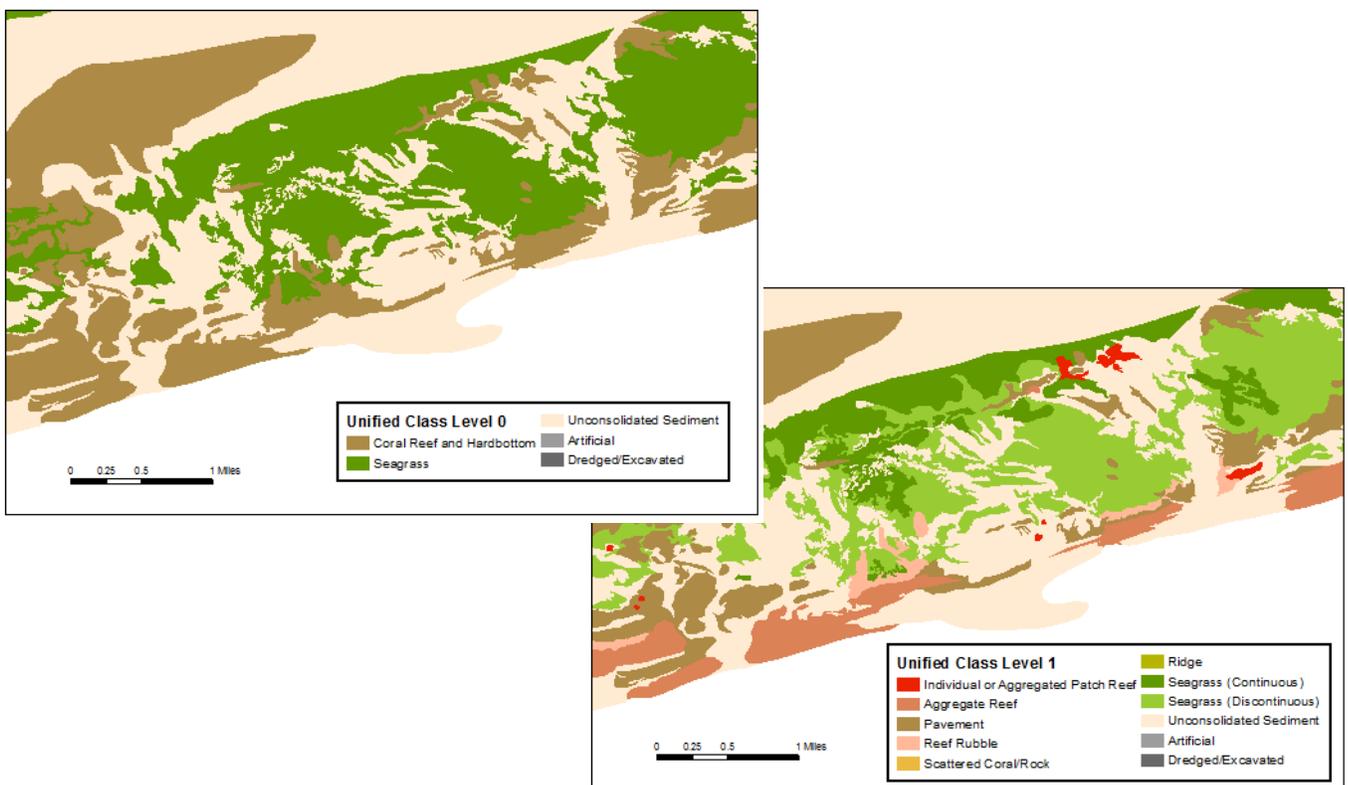


Figure 3. UC Levels 0 and 1 at Looe Key

Hypothetical Example Scenario #2: A vessel runs aground on a coral reef in Biscayne National Park. The vessel drags across the coral reef creating a scar track. An estimate of seafloor habitat types affected by the grounding is needed. The grounding happened to occur in an area where two maps overlapped (Figure 4). At this location, the National Park Service (NPS) map was created using a finer scale minimum mapping unit than the NOAA map; therefore, it provides more spatial detail.

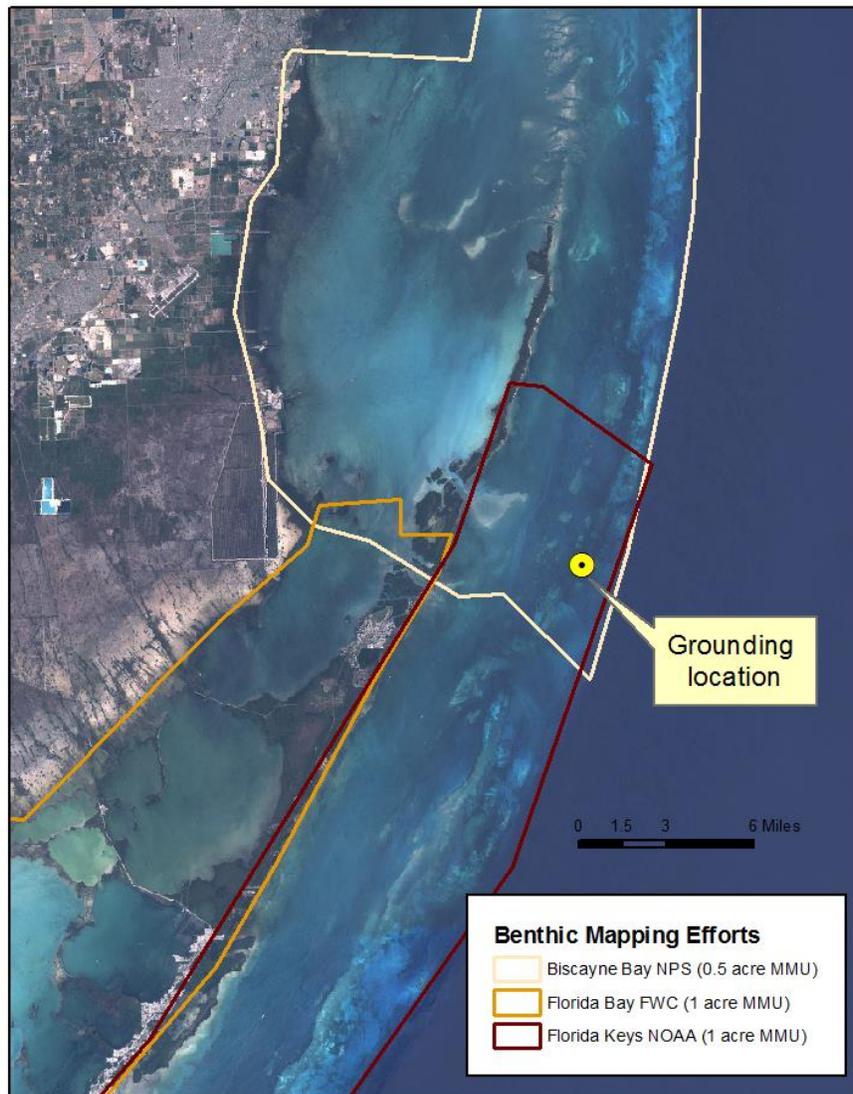


Figure 4. Location of hypothetical grounding event relative to available benthic maps

Comparing the vessel grounding location to the benthic map provides an initial assessment of what benthic types may be affected by the grounding. A 500-meter buffer around the scar track is created to represent the area that may be affected by the vessel grounding event. Differences between spatial resolutions for this area can be visualized in Figure 5. To represent this small area, the NPS map may be more appropriate as it provides higher spatial resolution. Note that even the finer scale map will not capture every small unique seafloor feature. Since this analysis would only be applied to a single map and a small area, UC Level 4 may be useful as it provides all classification detail from the original source map. In reality, a field survey would be necessary to assess benthic habitats affected by the grounding event.

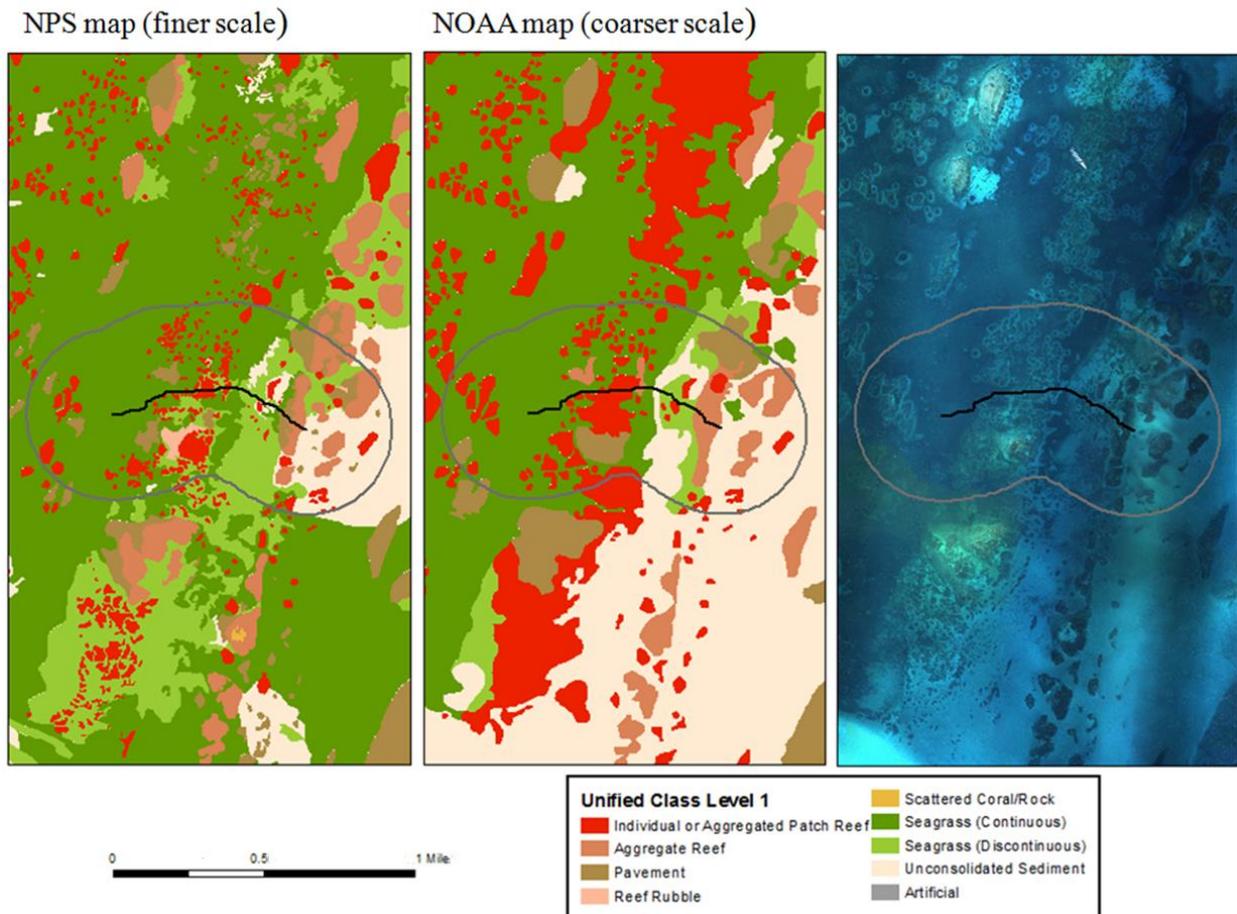


Figure 5. Hypothetical scar track (black line) created by a vessel grounding with a 500m buffer (gray line) laid over 2 different maps and an aerial photograph.

It turns out that the hypothetical vessel grounded on the coral reef is an oil tanker. The vessel's hull fractures and oil is released into the ocean. Much of the oil is spread far across the Florida Coral Reef Tract by winds and currents before boom can be deployed around the vessel to contain the spill. Satellites are used to map the extent of the oil slick on the surface of the water. Figure 6 shows the 12,000-square-kilometer extent of the hypothetical oil slick. The Unified Reef Map provides a useful tool for evaluating impact from the oil spill because it provides a more consistent picture of the entire spill area, particularly given that the oil slick intersects multiple mapping areas with varying scales and classification methods.

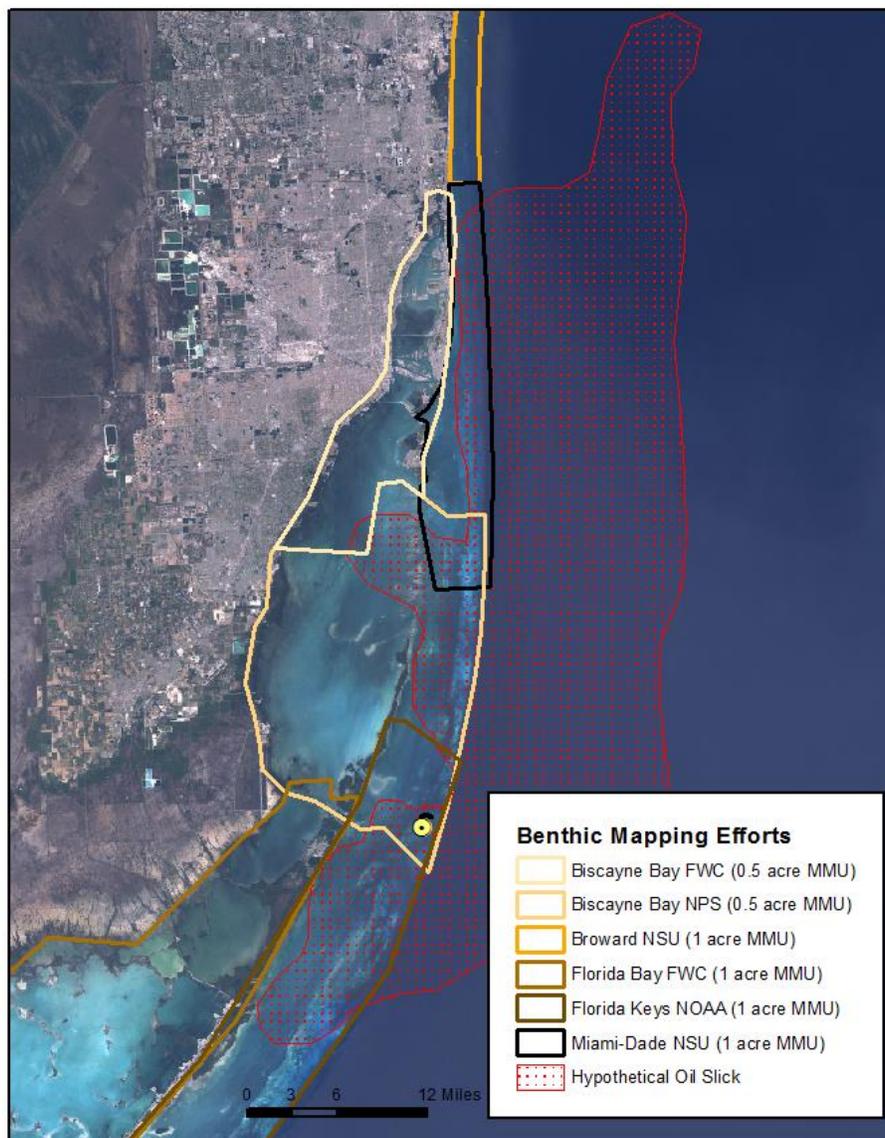


Figure 6. Extent of oil slick

➤ Version Notes

The Unified Reef Map is periodically updated to integrate new map data as they are provided by our partners. Version numbers will be used to track updates. All online data will be automatically updated with new versions including the downloadable Layer Package, Web Map Applications and Web Map Services. If you are using the Layer Package file it is recommended that you check the URM website periodically for new version releases.

Version 1.0 - published September 2013

- Preliminary integration of existing map data throughout the Keys

Version 1.1 - published January 2014

- Data addition: Biscayne Bay Aquatic Preserve
- Zone information added for southeast Florida and Marquesas

Version 1.2 - published September 2014

- Data additions: Final draft of Hawk Channel and Final draft of Boca Grande Channel

Version 1.3 - published September 2015

Data additions: Northern Marquesas and Backcountry areas and the standalone Unified Patch Reef layer. Minor topology errors were corrected throughout the map.

Version 2.0 - published September 2016

- Data additions: Southeast Florida benthic habitat update and integration of the formerly stand-alone Unified Patch Reef layer. Minor topology errors were corrected throughout the map.