

# Puerto Rico Coral Reef Monitoring Program: External Monitoring Datasets

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*Submitted to the DNER Coral Reef Conservation and Management Program  
(CRCMP)*

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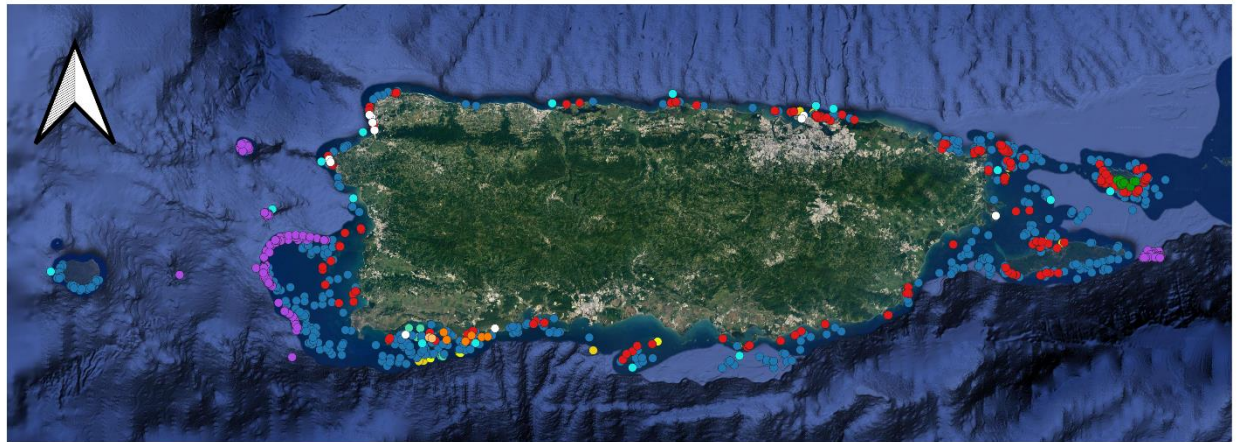
## **Advances in the development of the Puerto Rico Coral Reef Monitoring Program: External Monitoring Unit (PRCRMP-EMU)**

The Puerto Rico Coral Reef Monitoring Program collects data from benthic and fish communities in multiple coral reefs of high value in Puerto Rico since 1999. The main variables available from the PRCRMP include benthic cover percent, and fish size and abundance. However, during recent efforts (2017) to evaluate the usefulness of PRCRMP data, it has been identified that several data gaps still exist, such as data regarding water quality, coral recruitment, anthropogenic impacts, and important associated habitat such as mangroves, and seagrasses. To address this need, it was recommended that the PRCRMP develop an “External Monitoring Unit” (PRCRMP-EMU) through the hiring of a data manager with expertise in coral reef monitoring. For the development of the EMU, a series of interviews were carried out through 2018-2021 with local researchers who conduct coral reef monitoring research. A key product of this effort was a matrix with profiles for entities and researchers who collect coral reef and associated ecosystem data, externally to the DNER PRCRMP.

During 2022, a total of 11 databases with data from coral reef waters were obtained from online repositories and individual researchers. These datasets were incorporated into a georeferenced archive containing raw data and the location of each sampling point. A map (Figure 1.) was produced to visually identify areas with data collected outside of the PRCRMP monitoring agenda. All points in the map include metadata from each sampling location such as email from dataset POCs, data contributor affiliation, reference links for download (when available), data types available, and coordinates. The following datasets were obtained:

<i>Project- Database Name</i>	<b>Source</b>	<b>POCs</b>	<b>Reference - Download Links</b>	<b>Raw Data Onli ne</b>	<b>Year- Period</b>
<i>PR SCTLD Interventi ons</i>	PR- DNER Coral Progra m / Sea Venture s MRU	mfiguerolahernandez@gmail.com; programadearrecifesdecoral@gmail.com; catalina.morales1@upr.edu	n/a	No	2019- 2022
<i>SCTLD Roving Diver Surveys</i>	Sea Venture s MRU	<a href="mailto:catalina.morales1@upr.edu">catalina.morales1@upr.edu</a>	n/a	No	2019- 2022
<i>Coral reef communit y structure in La Parguera Natural Reserve</i>	UPR- Depart ment of Marine Science	miguel.figueroa@upr.edu; mfiguerolahernandez@gmail.com; ernesto.weil@upr.edu	<a href="https://scholar.uprm.edu/handle/20.500.11801/2620">https://scholar.uprm.edu/handle/20.500.11801/2620</a>	No	2003- 2016
<i>NCRMP Benthic Data</i>	NOAA CRCP	erica.towle@noaa.gov; sarah.groves@noaa.gov; jay.grove@noaa.gov	<a href="https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:NCRMP-Benthic-PR">https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:NCRMP-Benthic-PR</a>	Yes	2014- 2021
<i>Post- Maria Hurricane Damage Assessme nt</i>	NOAA NCCOS	shay.viehman@noaa.gov; sarah.groves@noaa.gov;	<a href="https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0221189">https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0221189</a>	Yes	2018
<i>Fish Assembla ges Associate d With Reef Types</i>	UPR- Depart ment of Marine Science	manuel.nieves1@upr.edu; juan.cruz13@upr.edu	<a href="https://www.science-direct.com/science/article/abs/pii/S0964569121003847">https://www.science-direct.com/science/article/abs/pii/S0964569121003847</a> ; <a href="https://www1.usgs.gov/obis-usa/ipt/resource?r=puerto-rico-coral-reef-fish-">https://www1.usgs.gov/obis-usa/ipt/resource?r=puerto-rico-coral-reef-fish-</a>	Yes	2018- 2019

			assemblages-2018-2019		
<i>Guanica Rapid Assessment</i>	UPR- Department of Marine Science	Ernesto.weil@upr.edu	n/a	No	2018-2019
<i>Culebra Seagrass Characterization</i>	NOAA RC / Protectores de Cuencas	lisa.vandiver@noaa.gov	n/a	No	2022
<i>Water Quality Virtual Buoys</i>	USF- College of Marine Science	huc@usf.edu; jmorell55@gmail.com	<a href="https://optics.marine.usf.edu/index.html">https://optics.marine.usf.edu/index.html</a>	Yes	2000-2022
<i>Orbicella faveolata skeleton benthic cover</i>	UPR- Department of Marine Science	catalina.morales1@upr.edu; ernesto.weil@upr.edu	<a href="https://scholar.uprm.edu/handle/20.500.11801/2595?show=full">https://scholar.uprm.edu/handle/20.500.11801/2595?show=full</a>	No	2017-2018
<i>Mesophotic benthic habitats and associated marine communities</i>	CFMC	<a href="mailto:goingdeep49@gmail.com">goingdeep49@gmail.com</a> ; <a href="mailto:graciela_cfmc@yahoo.com">graciela_cfmc@yahoo.com</a>	<a href="https://caribbeanfmc.com/library-f">https://caribbeanfmc.com/library-f</a>	No	2004-2020



- External Monitoring Database Inventory (7-30-2022)
- Coral reef community structure in La Parguera Natural Reserve
  - Culebra Seagrass Characterization
  - Fish Assemblages Associated With Reef Types
  - Guanica Rapid Assessment
  - Mesophotic benthic habitats and associated marine communities
  - NCRMP Benthic Data
  - Orbicella faveolata skeleton benthic cover
  - Post-Maria Hurricane Damage Assessment
  - PR SCTL Diver Interventions
  - SCTL Diving Surveys
  - Water Quality Virtual Buoys
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- Google Satellite

**Puerto Rico Coral Reef Monitoring Program  
External Monitoring Locations**

**Raw data available by database POCs**

- 11 database sources
- 9 contributing entities
- 1,149 sampling locations

**Figure 1. Map of locations with coral reef monitoring data external to the PR-DNER PRCRMP.**

Most of these datasets include recent data (since 2015). Long-term data is provided by two datasets, one for water quality and another for mesophotic coral reef communities. One of these includes water quality data derived from the MODIS AQUA sensor for priority locations around Puerto Rico identified by local coral reef managers and researchers. Regarding coral recruitment, a key measurement component that has been recommended to be added to the PRCRMP methodology, one dataset with recruitment data from La Parguera Natural Reserve was obtained from a master’s thesis at the University of Puerto Rico. A total of 1,149 sampling locations were added to the map from these datasets. Datasets contributing to most of the sampling locations include the National Coral Reef Monitoring Program (NCRMP) and the Post-María Hurricane Damage Assessment, both efforts led by NOAA CRCP and NOAA NCCOS.

## **Recommendations to integrate external datasets into the PRCRMP**

The following tasks can be taken to support the use of external data compiled in this effort as part of the PRCRMP External Monitoring Unit.

- Conduct data analyses regarding the key questions of the PRCRMP:
  - What is the condition (status and trends) of high-value coral reef communities?
  - What stressors affect these communities?
  - What management actions can be implemented to address these?
- Continue data sourcing by stakeholder engagement. Emphasize the benefits of sharing their data with the PR-DNER Coral Program.
- Promote awareness of the value of these datasets through targeted outreach activities such as symposia, webinars, and planning meetings. Increasing the visibility of these datasets is important for further stakeholder engagement and expanding the inventory of external coral reef data.
- Include a map with external data sampling locations on the DNER Coral Program website for increasing data visibility.
- Standardized the external data archive with common metadata fields. Expand current metadata to include data abstracts and methodologies.
- Formalize data-sharing agreements between the PR-DNER and permittees as part of the research permit application process. Require copies of raw data files and data dictionaries along with final project reports.
- Target high-value datasets to translate following Darwin Core standards to be ingested into information systems and visualization tools such as the Oceanographic Biodiversity Information System (OBIS) and the Marine Biodiversity Observation Network (MBON). Continue collaboration with CARICOOS in this regard.

### **Access to external dataset archive:**

All raw datasets and georeferenced inventory obtained in this effort are submitted to the PR-DNER coral program virtually through the following google drive folder:

**[https://drive.google.com/drive/folders/1i9cNwqA\\_GHL1bYCHEGHvIzAFLgRaDkax?usp=sharing](https://drive.google.com/drive/folders/1i9cNwqA_GHL1bYCHEGHvIzAFLgRaDkax?usp=sharing)**