

The National Coral Reef Monitoring Program's Environmental Monitoring in the Florida Keys National Marine Sanctuary

Nicole Besemer¹, Ana Palacio-Castro², Alice Webb³, Graham Kolodziej⁴, Erica Towle⁵, Taylor Gill², Albert Boyd², Ben Chomitz², Mike Jankulak², Ian Enochs¹

¹NOAA, Atlantic Oceanographic and Meteorological Laboratory, Ocean Chemistry and Ecosystem Division, Miami, FL USA

²University of Miami, Cooperative Institute for Marine and Atmospheric Studies, Miami, FL, USA

³University of Exeter, Department of Geography, Faculty of Environment, Science and Ecology, Stocker Rd, Exeter EX4 4PY, United Kingdom

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⁵NOAA, Coral Reef Conservation Program, Office for Coastal Management, Silver Spring, USA

The National Coral Reef Monitoring Program (NCRMP) was established in 2013 by the National Oceanic and Atmospheric Administration (NOAA) to monitor the status and trends of coral reefs across US jurisdictions in both the Atlantic and Pacific, including fish communities, benthic composition, environmental drivers and impacts, as well as socioeconomic indicators. NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) is responsible for the environmental components of this monitoring within the Atlantic and Caribbean, including South Florida and the Florida Keys. Here, we will provide an overview of the monitoring efforts and share some of the research produced from this data. This monitoring is organized according to a tiered approach to capture both spatial and temporal variability. To describe spatiotemporal trends in ocean acidification and carbonate chemistry in the Florida Keys, water samples are collected every two months at 38 sites across the reef tract. Samples are analyzed for dissolved inorganic carbon (DIC), total alkalinity (TA), and pH (total scale), which are used to solve the carbonate system. To characterize higher frequency variation in carbonate chemistry (e.g., diel and episodic fluctuations), a MAPCO₂ buoy at Cheeca Rocks measures the partial pressure of carbon dioxide (pCO₂) every three hours. Spatiotemporal variation in temperature is assessed using subsurface temperature recorders (STRs), which are programmed to collect high-precision temperature measurements every five minutes at four different depths (1-25m) in each of five biogeographic regions (Biscayne National Park, Upper Keys, Middle Keys, Lower Keys, and Dry Tortugas), encompassing a total of 24 sites. Finally, reef ecosystem responses to these environmental drivers are assessed using an array of metrics known to be sensitive to acidification and temperature. Changes in benthic community composition and reef structure are quantified using landscape photomosaics and diver-based carbonate budget surveys. Environmentally sensitive biological processes underlying these trends include coral growth and bioerosion. The growth rates of five species of reef-building coral are quantified using coral cores, which are CT-scanned to determine linear extension, density, and calcification. Bioerosion is quantified using micro-CT scans of bioerosion monitoring units (BMUs) at 12 sites throughout the Florida Keys. All monitoring data, including environmental conditions as well as biological responses, are compiled into regional assessments that provide an overview of the status and trends of reefs in the Florida Keys National Marine Sanctuary. They are also used for a variety of management-relevant science projects that aim to synthesize and project reef ecosystems persistence. This data is publicly available and provides an opportunity to further our understanding of Florida's Coral Reef.