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St. Petersburg Coastal and Marine Science Center Coral Reef Research

Introduction

Coral reefs provide important ecosystem services such as shoreline protection and the support of industries including fisheries and tourism. Such ecosystem services are being compromised as reefs decline as a result of coral disease, climate change, overfishing, and pollution (fig. 1). There is a need for focused, integrated science to understand the complex ecological interactions and effects of these many stressors and to provide information that will effectively guide policies and best management practices to preserve and restore these important resources.

Focus of Research

The U.S. Geological Survey (USGS) Coral Reef Ecosystem STudies (CREST) Project specifically addresses priorities identified in the U.S. Geological Survey Circular 1364, "Strategic science for coral ecosystems" (USGS, 2007). Research includes a blend of historical, monitoring, and process studies aimed at improving our understanding of the development, current status and function, as well as likely future changes in coral ecosystems. Topics such as habitat characterization and distribution, coral disease, and trends in biogenic calcification and climate are major focus areas. We seek to increase the understanding of reef structure, ecological funtioning, and responses to global change.

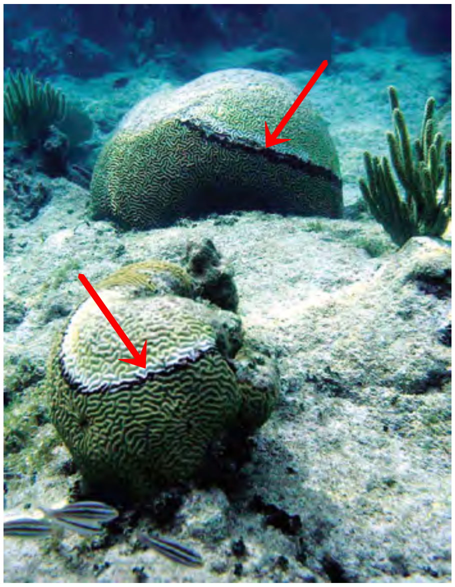


Figure 2. Black-band disease has infected these coral colonies of *Diploria strigosa*, an important reef-building species. Photo credit: T.D. Hickey.

Specific research activities include:

- Characterizing coral-associated microbial communities and investigating disease and disease processes (fig. 2)
- Identifying response of coral reefs to past and present climate and sea-level changes (fig. 3)
- Mapping and characterizing coral reefs and critical benthic habitats used by endangered species (fig. 4)
- Quantifying changes and trends in biogenic calcification in response to ocean warming, and changing ocean chemistry (fig. 5), and
- Evaluating existing and future threats to coral reefs by increased atmospheric carbon dioxide and ocean acidification (fig. 6).

Figure 3. A, Core sampling provides information about coral growth rates and geologic history. Photo credit: T.D. Hickey. B, An x-ray of a *Montastraea faveolata* core slab showing alternating light and dark layers (bands) that are the result of seasonal changes in growth rate and differences in skeletal density. Each high and low density couplet represents 1 year of growth and can be used to determine the age of the coral by counting down the core from the known year it was sampled.

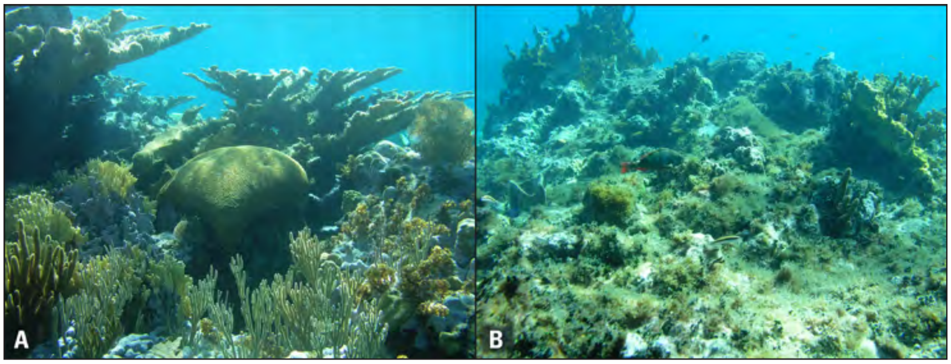


Figure 1. Coral reef habitat (A) dominated by reef-building corals (Great Exuma, Bahamas) and (B) covered with non-calcifying fleshy algae (Europa Bay, U.S. Virgin Islands). Photo credits: I.B. Kuffner.

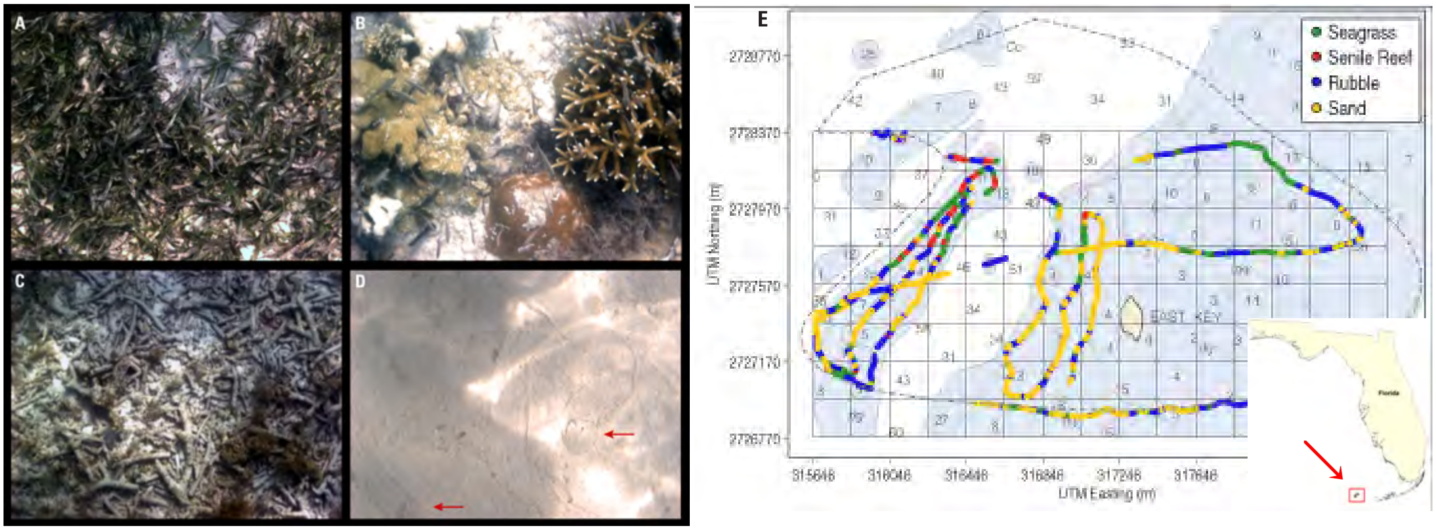


Figure 4. Examples of Along Track Reef Imaging System (ATRIS) imagery collected in Dry Tortugas National Park, Florida showing bottom habitat with (A) the seagrass *Thalassia testudinum*, (B) identifiable colonies of fire coral and staghorn coral, (C) rubble consisting primarily of staghorn coral sticks, and (D) carbonate sands with tracks of benthic organisms (arrows). Photo credits: D.G. Zawada. (E) Shallow-ATRIS transect lines colored-coded by benthic habitat to describe endangered turtle habitat core-use areas as determined by tagging and tracking studies. The underlying map was excerpted from the free digital version of NOAA Raster Navigational Chart #11438, edition 13.

Figure 5. Calcification monitoring station at Fowey Rocks Light, off Miami, with a curious reef squid looking on. Photo credit: T.D. Hickey.

Relevance to Management

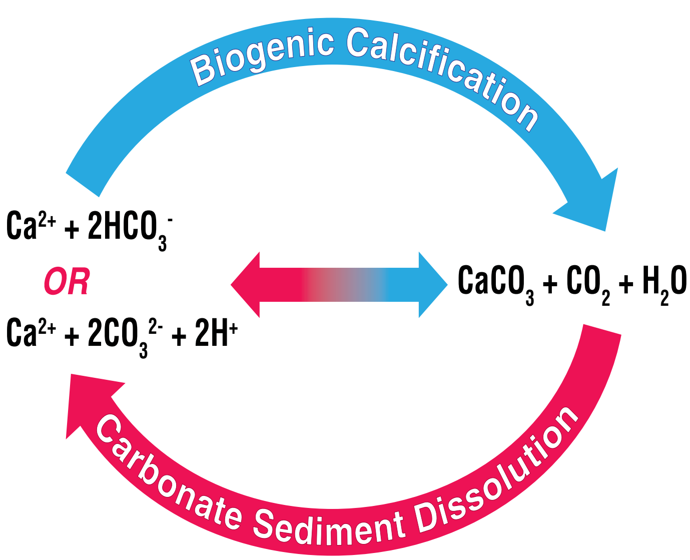
Project activities primarily focus on work related to the health and resilience of shallow-water reef environments in the Dry Tortugas, Virgin Islands, and Biscayne National Parks, and selected areas of the Florida Keys National Marine Sanctuary. The ultimate goal of our research is to provide information and datasets that will advance our ability to understand cause and effect relationships between environmental variables and reef decline. The breadth of studies included in this project will provide data on past coral ecosystem functioning and response to stressors and will provide datasets to predict future responses.

Current Activities and Results

Information on current activities and project results are available on the CREST Project web page.

http://coastal.er.usgs.gov/crest/

Figure 6. The chemical reactions associated with biogenic calcification and carbonate sediment dissolution are reversible. Calcification occurs when calcium (Ca^{2+}) combines with bicarbonate (HCO_3^-) or carbonate (CO_3^{2-}) to form calcium carbonate ($CaCO_3$), carbon dioxide (CO_2), and water (H_2O). The reverse reaction occurs when CO_2 increases and seawater pH decreases, resulting in dissolution of $CaCO_3$.



References

U.S. Geological Survey, 2007, Strategic science for coral ecosystems: U.S. Geological Survey Circular 1364, 23 p. [also available at http://pubs.usgs.gov/circ/1364/].

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