

VIII. Conclusions and future efforts

Survey results from 2008 add to a growing dataset on the distribution, abundance, size, and condition of benthic coral reef organisms in the Florida Keys National Marine Sanctuary, as well as neighboring State and National Parks. For many of the variables assessed, we have developed a 10-year record to evaluate the efficacy of zoning strategies in the context of larger-scale environmental variability. Benthic surveys completed in 2008 included a follow-up effort to sampling conducted in 2000-2001 that evaluated the spatial extent and impacts of marine debris, with a particular focus on comparisons inside and outside of most of the Sanctuary no-fishing zones. It is important to note our analyses not reported here will yield domain-wide abundance estimates for the benthic invertebrates sampled, and population estimates structured by habitat, regional sector, and for individual no-take marine reserves.

Acropora corals

For *Acropora* corals, transect surveys of presence-absence and frequency of occurrence yielded results similar to what we documented in both 2006 and 2007. The distribution and abundance patterns of the two species are clearly different, perhaps necessitating discrete management approaches. Significant *A. palmata* stands remain at only a handful of sites, all of which are high-relief spur and groove reefs on the inner or outer platform margin, and most of which are within existing FKNMS no-take zones. Tissue damaged caused by snails and damselfishes, as well as physical impacts from lost fishing gear continue. In contrast, mid-channel and offshore patch reefs yielded the greatest proportion of sites and transects where *A. cervicornis* was present, while the species was rare on the shallower and deeper platform margin. With over 5,000 patch reef sites on the south Florida shelf, *A. cervicornis* is currently variably distributed and the factors responsible for this pattern are not clear. It is noteworthy that few patch reef areas are included within the existing FKNMS zoning framework as no-take zones. In general, patch reefs represent many of the best remaining reefs in the region in terms of coral abundance and diversity, in addition to their importance as habitat for *A. cervicornis*. Why patch reefs appear to be in relatively good condition compared to the offshore spur-and-groove habitats is an important research and management question.

Urchins

Urchin density and size estimates during 2008 continue a decade-long record of population status in the Florida Keys. Results indicate that since 1999, *Diadema antillarum* prevalence and average size both have increased. However, maximum site-level densities are still at least one order of magnitude lower than before the Caribbean mass mortality event in 1983-84 and the second dieback in the Florida Keys that occurred during 1991. Increasing *Diadema* density and size are likely to result in corresponding

changes in coral-algal relationships and thus represents an important aspect of our monitoring effort. Other urchin species exhibit spatial distribution and abundance patterns similar to historical observations, with high densities of *Echinometra* on some patch reefs and *Eucidaris tribuloides* abundant on the shallow fore-reef.

Anemones and corallimorpharians

Anemone and corallimorpharian surveys indicated similar patterns in species distribution and abundance with historical observations dating back to 1999. Most anemones were either found in low densities among most habitats, or were relatively rare and confined to a few habitats. The three corallimorpharian species were particularly abundant in the patch reef environment, especially in Sanctuary no-take zones. The degree to which the distribution and abundance patterns of these organisms are affected by the marine aquarium trade is not well known. In 2009, we will be collaborating with the Florida Fish & Wildlife Research Institute to combine ocean-side and nearshore-Florida Bay-Biscayne Bay surveys, along with fishery-dependent data on landings and aggregation locations, to provide both fishery-dependent and independent assessments.

Marine debris

A concerted effort to document the spatial extent, amount, and impacts of marine debris in 2008 indicates similar results with surveys dating back eight years ago. Marine debris, most of which is derelict angling and trap gear, is ubiquitous in the Sanctuary, even within no-take zones. The sheer amount of debris recovered is testament to an increasingly visited and exploited marine ecosystem. We believe that the site-level data can help focus coordinated efforts to remove marine debris entangled on benthic biota. The amount of marine debris found in no-take zones has obvious management implications related to education and enforcement.

Future plans

In 2009, we plan to conduct a synoptic inventory of the abundance, size, and condition of coral reef benthos from northern Biscayne National Park to near the Marquesas Keys. Data will be collected on species richness, cover, animal densities, and sizes. We also plan to incorporate surveys of marine debris as well, as we will be concentrating on FKNMS no-take zones and comparable reference areas. Results from this program were recently presented at the Florida Academy of Sciences meeting in March 2008 and the International Coral Reef Symposium in Ft. Lauderdale during July 2008, in which three manuscripts on *Acropora* coral status, urchins, and Florida Keys reef status were submitted. Survey results from 2008 will be presented at the upcoming Florida Academy of Sciences meeting in March 2009.

and the International Marine Conservation Congress in May 2009. A list of previous publications based on results from this program follows. We also have several manuscripts drafted on the distribution and abundance of corals, gorgonians, and sponges, that we are going to complete after our 2009 surveys so we can provide nearly a decade-long – and Keyswide – report on these prominent components of the benthic community.



Manuscripts published

Ault JS, Smith SG, Meester GA, Luo J, Bohnsack JA, Miller SL (2002) Baseline multispecies coral reef fish stock assessment for the Dry Tortugas. NOAA Technical Memorandum NMFS-SEFSC-487, 117 p

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