

IX. Conclusions and Future Efforts

Survey results from 2011 add to a growing dataset on the distribution, abundance, size, and condition of benthic coral reef organisms in the Florida Keys National Marine Sanctuary (FKNMS). For many of the variables assessed, we have now developed a 12-year record dating back to 1999 to evaluate benthic community structure and change in no-take zones throughout the Sanctuary. Our monitoring is also conducted to address the larger-scale habitat variability of coral reef and hard-bottom habitats found throughout the FKNMS. This larger perspective allows us to interpret results from no-take-zones within the context of natural system variability and the various factors that can impact hard-bottom and coral reef communities. Benthic surveys completed in 2011 in the upper Florida Keys region included *Acropora* corals, non-*Acropora* corals, urchins, anemones, corallimorpharians, mollusks, and marine debris. We have previously sampled the upper, middle, and lower Florida Keys three times in the last eleven years, with additional periodic efforts conducted in-between that focus regionally or on a subset of our total benthic variable list.

Despite the continual bad news typically reported in the press about the condition and fate of coral reefs, worldwide and in Florida, our results suggest that there is also good news to report, based on our 2011 surveys in the upper Florida Keys, including:

- Staghorn corals (*Acropora cervicornis*) still occur in relatively large numbers, even though colonies are mostly small (< 1 m) and found largely in the patch reef environment. Most of the staghorn corals in the upper Keys are currently found outside of FKNMS no-take zones.
- Large (10-15 m diameter) thickets of elkhorn coral (*A. palmata*) continue to persist at several platform margin reefs. Most of the remaining thickets of elkhorn coral occur within the boundaries of existing FKNMS no-take zones.
- Many other coral species continue to exist at relatively high densities and large sizes in certain habitats, especially patch reefs.
- Urchins, specifically *Diadema antillarum*, continue to show slow, but consistent increases in abundance and size. It appears the back-reef rubble continues to provide an important recruitment habitat for *D. antillarum* and other echinoids, although the fate of these post-settlement juveniles has not been studied.

There are also many observations and patterns that are not so encouraging.

- While staghorn corals are abundant and small (< 1 m diameter), no extensive thickets have been observed now for several years. In addition, fore-reef areas that historically supported extensive stands appear devoid of staghorn corals.
- Elkhorn corals are extremely limited in distribution and continue to suffer tissue loss from predation. Some reef flat and reef crest areas that historically supported dense stands appear to be devoid of this species.
- Urchin densities, specifically *Diadema antillarum*, are still a hundred times less abundant than values reported prior to the 1983-84 mortality event.
- *Coralliophila* snails appear to be increasing in abundance and are found preying upon a greater variety of coral species than we have observed before.
- Marine debris, especially lost fishing gear that becomes entangled on the seabed, continues to be pervasive in many habitats, especially patch reefs, and in most of the FKNMS no-take-zones.
- Inshore and some bank/channel patch reef areas affected by the January 2010 cold-front event suffered extensive mortality of some stony coral (e.g. *Montastraea* spp.) and gorgonian species and are now largely covered with turf and drift algae. However, this pattern is not apparent on reefs further offshore.
- During 2011, we encountered more lionfish at more sites than ever before. All of the individuals observed were relatively small (probably juveniles) and were largely found on patch reefs.

The cumulative results of our program define baseline conditions for coral reef community structure throughout the FKNMS and Dry Tortugas, including marine protected areas. However, sampling only began in 1999 and thus represents an effort established long after major declines had already occurred throughout the system, especially related to the loss of *Acropora* corals from disease, starting in the late 1970s, the demise of the urchin *Diadema antillarum* in the early 1980s, coral bleaching, first noted as a regional phenomenon in the early 1980s and periodically since then, and various other stressors that impact this ecosystem. However, because we sample system-wide, and because we sample much more than just corals, results from our program will help us distinguish between changes that result from no-take management strategies and natural system variability.

In 2012, we will be coordinating a region-wide assessment of *Acropora* corals in U.S. territorial waters, including southeast Florida, the U.S. Virgin Islands, and Puerto Rico. We plan to survey *Acropora* corals for abundance, size, and condition throughout most of the Florida Keys ecosystem, specifically from northern Biscayne National Park to the Marquesas Keys. Based upon funding, we also intend to sample Keys-wide for urchins, anemones/corallimorpharians, selected mollusks, and marine debris. We are also

seeking funding to additionally sample our full suite of benthic variables, as we have done Keys-wide three times previously, including other corals, gorgonians, and sponges. Because we are coordinating the *Acropora* sampling efforts in the U.S. Caribbean, we completed a second draft of a Field Protocol Manual in December 2011 to help standardize regional survey efforts.

In 2012, we also plan to continue our collaboration with Nancy Sheridan of the Florida Fish & Wildlife Research Institute to sample ocean-side and nearshore-Florida Bay-Biscayne Bay hard-bottom and seagrass matrix habitats for benthic community structure, with a focus on several species targeted by the marine aquarium trade. Along with fishery-dependent data on landings and aggregation locations, these data will provide both fishery-dependent and independent population assessments of targeted species. This will also provide an unprecedented data set from nearshore to offshore habitats for evaluating the population status of benthic organisms.

In 2012, we will also continue to analyze data and prepare publications. Of particular note is work related to our long-term record of surveys in the FKNMS and additional multivariate work related to describe the distribution and abundance of species and habitat types throughout the region. The data set provides unmatched spatial coverage of organism habitat distribution, density, and size, as well as a means to evaluate temporal changes related to the FKNMS zoning action plan relative to larger-scale phenomena. Below is a list of manuscripts published to date. Of particular note is a Ph.D. dissertation completed this year by Dr. Dione Swanson, based on work conducted with our program (Swanson 2011).

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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- Chiappone M, Miller SL, Swanson DW (2001) *Condylactis gigantea* – A giant comes under pressure from the aquarium trade in Florida. *Reef Encounter* 30: 29-31
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- Chiappone M, Swanson DW, Miller SL, Smith SG (2002) Large-scale surveys on the Florida Reef Tract indicate poor recovery of the long-spined sea urchin *Diadema antillarum*. *Coral Reefs* 21: 155-159
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