Scaling-up Florida Bay Sponge Restoration Efforts

Pilot-scale sponge restoration in Florida Bay is a proven success and scaling the restoration effort up is feasible, timely and sorely needed as it would provide clear benefits to the Florida Keys marine environment and economy.

Dr. Mark Butler from Old Dominion University and Dr. Don Behringer from the University of Florida and their colleagues initiated this restoration effort in 2009 in Florida Bay waters of Everglades National Park and the Florida Keys National Marine Sanctuary with financial support from the National Park Service and the NOAA-Nature Conservancy Community-based Restoration Program. At the conclusion of the pilot effort in 2014 tremendous progress had been achieved despite negative impacts from the severe cold event of January 2010.

This introduction to Behringer' s final report on the most recently completed phase of the project highlights why this work is so important:

"The ecological function of shallow hard-bottom communities in the Florida Keys National Marine
Sanctuary (FKNMS) and Everglades National Park (ENP) has been severely degraded having experienced large-scale sponge die-offs in recent decades caused by blooms of cyanobacteria - unique events rarely reported in the past 100 years. The 2007 event, for example, destroyed sponge communities in an area
>500km2 and at the most severely impacted sites, 22 of the 24 common species of sponges experienced >90% mortality, including all the commercial and large, structure-forming species. Large sponges, some as large as truck tires and probably hundreds of years old, normally dominate hard-bottom animal community biomass in the region. Their nearly complete decimation in central Florida Bay greatly diminishes ecosystem biodiversity and weakens the function of hard-bottom as a back-reef nursery habitat essential to many species, including one that is the focus of Florida's most valuable fishery - that for the Caribbean spiny lobster (Panulirus argus)."

The basic restoration approach is quite simple. Whole sponges or cuttings of sponges collected from donor sites are affixed to concrete weights and allowed to heal on the seafloor at the collection site. Then they are moved to the restoration sites where most of them survive and thrive, increasing the viability of the sponge populations and providing water quality and habitat benefits at the restoration site itself while also serving as sources of sponge larvae that may repopulate degraded areas remote from the restoration site.

To date, restoration efforts have been successful utilizing a variety of sponge species that serve different ecological functions: large, structure forming sponges (loggerhead sponge, Spheciospongia vesparium; vase sponge, Ircinia campana), fast growing, medium-sized "weedy" species (brown branching, Ircinia spp), and ecologically sensitive species that also support commercial sponge fisheries (glove sponge, S. cheris). A second suite of sponge species - sheepswool sponge (Hippospongia lachne), yellow sponge (Spongia barbara), fire sponge (Tedania ignis), and yellow rope sponge (Aplysinia fulva) - was tested for restoration suitability in 2014 but results are not yet available.

Glove sponges proved to be uniquely sensitive to the 2010 cold snap and suffered severe losses, but the other sponge species have shown the following results (excerpted from Behringer' s final report):

- Sponge Survival: Sponge survival during the initial 2-3 month post-cutting healing period prior to transplantation ranges from 75-90% for all the [8] species we have worked with so far. Four years after transplantation onto restoration sites, the survival of the three species originally in our restoration plan has been very good, ranging from 60% to nearly 90%.

- Sponge Filtration and Growth: We have not yet had ample time to analyze all of the filtration and growth data, the most important of which is the final growth data just collected this month. However, there has been phenomenal growth of transplanted sponges as is obvious from observation of their change in size, and it is thus highly unlikely that restored sponges experienced any problems with filtration. Growth of both sponge cuttings and whole sponges is so great that after 4 years the concrete paver bricks and patio stones to which they are attached are usually no longer visible, having been overgrown with sponge tissue.

- Recruitment of New Sponges: We were also pleased to see that after only 4 years, our restoration sites harbored significantly higher numbers of new sponge recruits as compared to nearby (~1km away) unrestored control sites. Moreover, these results meshed perfectly with expectations based on the growth results. Whole-sponge transplant sites had significantly more new recruits than sponge cutting sites, although both sites contained equal overall sponge biomass.

- Restoration of Habitat Function: Data collected by divers on the number of fish and macroinvertebrates (e.g., lobsters, crabs, shrimps, anemones) present on the control, sponge cutting, and whole sponge sites during the summer 2013 clearly demonstrate how sponge restoration has improved the function of formerly disturbed areas as habitat for fish and invertebrates. Fish and macroinvertebrate densities were both approximately 40% higher on restoration sites than on control sites. Moreover, at least 18 species of fish were observed on the restoration sites as compared to 8 species on control sites. Macroinvertebrate diversity essentially doubled (from 6 to 11 species) on restoration sites as compared to control sites.

- Restoration of Underwater Soundscapes [a proxy for biological diversity and productivity]:
  Our results thus far indicate that sponge restoration sites, whether cutting or whole sponge sites, can indeed restore underwater soundscapes in terms of their spectral composition and loudness (dB), and with respect to key biogenic sound features. After 4 years post-restoration, restored sponge sites are similar in spectral composition to undisturbed, sponge-dominated hard-bottom sites. Restoration site soundscapes are louder and distinctly different than those on nearby unrestored control sites, particularly in the important biogenic frequency bands. Finally, the production of snapping shrimp snaps - a major component of the biogenic sound in the frequency band - is greater on restored sites than control sites, and similar to that on undisturbed, sponge-dominated hardbottom.

These results clearly indicate the potential for a wider scale restoration effort resulting in significant enhancements of water quality and habitat values. To that end, three/four non-profit conservation organizations are committed to providing a minimum of $155,000 and up to $ 205,000.over two years for expanded sponge restoration effort and associated scientific monitoring if a dollar-for-dollar public sector match can be secured.

We propose that this public sector match come from the FKNMS Water Quality Protection Program (WQPP) and that a sub-committee of the WQPP develop a request for proposal for the project, rank proposals and provide a funding recommendation to the WQPP.