Smithsonian
SMS News
The Smithsonian Marine Station at Fort Pierce
Summer 2016



Bivalves, like the hooked mussels in the containers above, were fed varied concentrations of the brown tide alga (seen in flask in rear of photo).

Bivalves and Brown Tides

Smithsonian scientists investigate role of bivalves on algal blooms

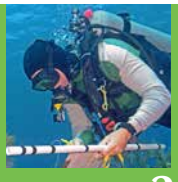
The population along U.S. coastlines has increased significantly in recent years, making it difficult to manage nutrient runoff into local waterways. Despite building sewage treatment plants and implementing municipal policies to prevent point-source pollution, diffuse nutrient sources are far more difficult to contain. Torrential rain events, for example, increase the amount of nutrients leaching into water bodies from commercial, municipal, and residential areas. This sudden influx of nutrients can lead to the development of algal blooms, altering the food web of the ecosystem. In combination with sunlight, these nutrients make up the diet of phytoplankton, tiny algal cells that spend much of their lives suspended in the water column. Under certain conditions, the phytoplankton cells multiply rapidly and become extremely abundant, forming an algal bloom. Not all algal blooms are toxic, but they always act as acute, and sometimes chronic, disturbances in coastal ecosystems.

The Indian River Lagoon (IRL) has faced a variety of environmental pressures for a number of years, and has recently suffered several algal blooms. The first was observed in 2011 and was formed by multiple types of phytoplankton. A second algal bloom, referred to as brown tide, occurred in 2012. This was followed by another brown tide in the northern section of the lagoon in late 2015 that lasted until March 2016. The brown tides are formed by the microalga *Aureoumbra lagunensis*, and have been responsible for seagrass loss and fauna mortality. Algal blooms comprised of this species can be very persistent. A brown tide in Laguna Madre, Texas that formed in 1989 lasted without interruption for almost eight years.

Researchers at the Smithsonian Marine Station, led by Dr. Eve Galimany, have been investigating the potential impact bivalves – like oysters, mussels, and clams - may have in mitigating blooms such as the brown tide. These "filter feeders" circulate water through their bodies, trapping phytoplankton and other food sources, and releasing excess water and undesirable organic and inorganic matter. After the 2015 bloom, SMS researchers investigated feeding differences in three bivalves native to the IRL - oysters, hooked mussels, and hard clams. They found that hooked mussels were the best at filtering the water. While the bloom was still developing and the algal concentration was low, the mussels filtered 19 gallons a day. At bloom concentration of one million algal cells per milliliter of water, the filtration rate fell to just over two gallons a day. The second best were the oysters, with 13 gallons/day during low bloom conditions and only 1 gallon/day under high bloom concentrations. Hard clams were the slowest, with less than a gallon a day during high algal concentration.

Dr. Galimany uses a tool she designed to measure bivalve filtration in the field.

Although all three bivalves decreased their filtration rate under bloom conditions, they did not stop filtering altogether like some other filter-feeding organisms. Dr. Galimany feels this is a good indication that they would have a positive impact on the IRL during an algal bloom. And consuming phytoplankton isn't the only benefit to the ecosystem that oysters, mussels, and clams offer. They also provide shelter and a source of food to fish and other invertebrates, and help maintain water clarity by holding sediment in place. Unfortunately, bivalve populations have decreased worldwide as a consequence of overfishing, diseases, and changes in their habitats. Nevertheless, Galimany says there is still hope. "If we restore the ecosystems with bivalves, we can bring back the healthy lagoon we all want to have." ***SMS***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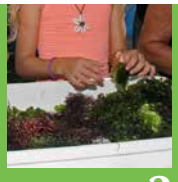
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In this issue:

CCRE Staff Keeping an Eye on the Reef

Above: CCRE Program Coordinator Scott Jones collects data along a reef transect in Belize.

This year marks the sixth year that staff from the Caribbean Coral Reef Ecosystems program (CCRE) and collaborators from the New England Aquarium have implemented the South Water Caye Marine Reserve (SWCMR) Reef Assessment Program. At over 100,000 acres, SWCMR is among the largest marine reserves in Belize and encompasses the waters around the Smithsonian's Carrie Bow Cay Field Station. The reef assessment project aims to identify effects of the no-take conservation zone around Carrie Bow Cay, established in 2010, on the recovery of fish and coral populations. In June 2011, permanent transects were established inside (12 transects) and outside (12 transects) the area's boundary and have been surveyed biannually since then. This amounts to over 264 unique surveys on the reefs around Carrie Bow Cay.

Reef monitoring efforts typically measure the diversity, abundance, and biomass of key reef organisms as indicators of reef health. CCRE's assessment program is designed to evaluate similar ecological metrics, so as to be compatible with other monitoring efforts elsewhere in Belize and the western Atlantic Ocean. But researchers have also added some assessments that yield information about key ecological rates and states that are thought to contribute to reef resistance, resilience, and recovery in the face of negative impacts. One example of the measured rates is the grazing rates of herbivores, such as parrotfishes and surgeonfishes, which help keep algae from overgrowing the reef. Researchers also monitor the "states" of the benthic community, such as the health status of important reef-building corals, as well as coral recruitment and growth dynamics. This approach provides more comprehensive ecological monitoring and informs models of reef dynamics that will be used to generate new insights into reef community structure in response to different reserve management regimes. This study is designed to take advantage of the strengths and capabilities of the Carrie Bow Cay Field Station and produce important information that will be applied to habitat management in the SWCMR no-take area.

Over the course of the project, researchers have documented declines in local populations of groupers and snappers, as well as an unusual winter coral bleaching event in 2015. Time will tell if the marine reserve has any influence on the recovery rates of these fish and coral populations, or on reef resilience and recovery overall.

For more information on the Smithsonian's CCRE program, visit **www.ccre.si.edu**. ***SMS***

IRL Science Festival Celebrates STEM

After only two years, the Indian River Lagoon Science Festival has become one of the premier family events on the Treasure Coast. On October 22, 2016 from 10am-3pm, the Festival is returning for a third year and promises to be better than ever. Although many "fan favorites" are returning as exhibitors - including USDA's cockroach racing, Harbor Branch's marine mammal ambulance, and a variety of Smithsonian displays - there are a number of organizations participating for the first time. Festival-goers will get a chance to launch rockets with NASA, learn about manned submersibles with Triton, and look for sun spots with the Treasure Coast Astronomical Society. Another change for 2016 is the location! The Festival has moved to downtown Fort Pierce along the waterfront at Veterans Memorial Park.

Although SMS leads the Festival initiative, it is a community-wide collaboration celebrating all areas of Science, Technology, Engineering, and Math (STEM). For more information on this fun-for-every-age event, please visit **www.irlsciencefest.org**. ***SMS***

Left: Community organizations, like Robotics for Kids, provided hands-on STEM fun.

Right: SMS had seven hands-on exhibits, including the always popular algae art!

New Faces at SMS

As a doctoral candidate at the University of West Indies in Jamaica, **Azra Blythe-Mallett** is investigating the genetic composition of Queen conch (*Strombus gigas*) populations as a management and conservation tool to protect this commercially important fishery. She is working with the Marine Conservation Program at SMS to process and analyze conch samples from representative populations across the Caribbean.

SMS/Link Fellow **Bart DiFiore** is pursuing his master's degree at the Yale School of Forestry & Environmental Studies, where he is using a combination of remote-sensing, satellite imagery, and field observations to examine predator-prey interactions around coral patch reefs, both inside and outside marine protected areas. While at SMS, Bart is conducting field experiments in the Florida Keys and around the Carrie Bow Cay Field Station in Belize.

Nicole Johnston is a doctoral student at Georgia Tech's School of Biological Sciences where she is conducting research on the impact of human-induced stressors on ecological functions of coral reef ecosystems. As an SMS/Link Fellow, she is focusing on how ocean acidification alters the chemically-mediated interactions between corals and algae.

Thankful for Your Support

Become a Friend of SMS

The staff of SMS extends a warm welcome and a big "thank you" to new and renewing members of *Friends of the Smithsonian Marine Station* who provide critical support for research and educational programs. For information on how to become a *Friend*, call 772.462.0977.

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FWRI Supports SMS

The staff of the SMS and SMEE are grateful for the ongoing support provided by the Florida Fish and Wildlife Conservation Commission through the Fish and Wildlife Research Institute. These funds allow us to conduct a number of research and education activities that would otherwise not be possible.

New Grants

Stephen Box received $1,300,000 from Oceans 5 for the project, "Improving Small Scale Fisheries Management and Compliance to Support the Expansion of Marine Reserves for the Mesoamerican Reef."

Stephen Box received additional funding of $68,414 from The Summit Foundation for the project, "Creating a Network of No-Take Zones in the Honduran Caribbean."

Melanie McField received $12,805.35 from MAR Fund for the project, "Interim Support for the Healthy Reefs Initiative."

Valerie Paul received additional funding of $116,004 from the University of Florida for the project "Novel Targeted Anticancer Agents from Marine Cyanobacteria."

Valerie Paul, Jennifer Sneed, and Justin Campbell received $37,000 from the Smithsonian Competitive Grants Program for Science for the project, "Can Corals Survive a 1-2 Punch? Combined Impacts of Ocean Acidification and Macroalgae on Coral Health and Recruitment."

Valerie Paul received $19,500 from The Link Foundation for the project, "Graduate Student Training in Marine Sciences 2016."

Max Teplitski received $14,139 from Mote Marine Laboratory for the project, "The Role of Native Bacteria of Boulder Corals in the Black Band Disease."

Selected Publications

Baeza, J. A., L. Simpson, L. J. Ambrosio, R. Guéron, and N. Mora. 2016. Monogamy in a hyper-symbiotic shrimp. PloS ONE, 11(3): e0149797.

Campbell, J. E., J. Fisch, C. Langdon, and V. Paul. 2016. Increased temperature mitigates the effects of ocean acidification in calcified green algae (*Halimeda spp.*). Coral Reefs, 35(1): 357-368.

Dangremond, E. M., I. C. Feller. 2016. Precocious reproduction increases at the leading edge of a mangrove range expansion. Ecology and Evolution, 6(14): 5087-5092.

Freeman, C. J., E. W. Stoner, C. G. Easson, K. O. Matterson, and D. M. Baker. 2016. Symbiont carbon and nitrogen assimilation in the *Cassiopea-Symbiodinium* mutualism. Marine Ecology Progress Series, 544: 281-286.

Gunasekera, S., L. Imperial, C. Garst, R. Ratnayake, L. Dang, V. Paul, and H. Luesch. 2016. Caldoramide, a modified pentapeptide from the marine cyanobacterium *Caldora penicillata*. Journal of Natural Products, 79(7): 1867-1871

Gunasekera, S., Y. Li, R. Ratnayake, D. Luo, J. Lo, J. H. Reibenspies, Z. Xu, M. J. Clare-Salzler, T. Ye, V. J. Paul, and H. Luesch. 2016. Discovery, total synthesis, and key structural elements for the immunosuppressive activity of Cocosolide, a symmetrical glycosylated macrolide dimer from marine cyanobacteria. Chemistry – A European Journal, 22(24): 8158-8166.

McKeon, C. S., M. X. Weber, S. E. Alter, N. E. Seavy, E. D. Crandall, D. J. Barshis, E. D. Fechter-Leggett, and K. L. Oleson. 2016. Melting barriers to faunal exchange across ocean basins. Global Change Biology, 22(2):465-473.

Meyer, J. L., S. P. Gunasekera, R. M. Scott, V. J. Paul, and M. Teplitski. 2016. Microbiome shifts and the inhibition of quorum sensing by Black Band Disease cyanobacteria. ISME J., 10: 1204-1216.

Olsen, K., J. M. Sneed, and V. J. Paul. 2016. Differential larval settlement responses of *Porites astreoides* and *Acropora palmata* in the presence of the green alga *Halimeda opuntia*. Coral Reefs 35(2): 521-525.

Ritson-Williams, R., S. N. Arnold, and V. J. Paul. 2016. Patterns of larval settlement preferences and post settlement survival for seven Caribbean corals. Marine Ecology Progress Series, 548: 127-138.

Tilley, A. and J. Lopez Angarita. 2016. Predicting vulnerability to management changes in data-limited, small-scale fisheries. Marine Policy, 72:211-218.

Winston, J. E. 2016. Bryozoa of Floridan *Oculina* reefs. Zootaxa, 4071 (1): 001-081.

Full STEAM Ahead at Aquarium

The Smithsonian Exhibit at the St. Lucie County Aquarium has long been a go-to venue for supporting and enhancing STEM (Science, Technology, Engineering, and Math) education. But staff are also advocates of adding "Art" and creating opportunities that take students and visitors from STEM to STEAM. The best example of this is the recent addition of large-scale murals in the Aquarium galleries.

Between 2003 and 2006, three static displays with complementary large-scale murals were installed in the Aquarium. These immersive exhibits provide context and a sense of place for Aquarium visitors and program participants, which makes them great teaching tools. That is why Aquarium staff once again worked with Chicago-based artist, Paul Barker, to design and paint two marine-themed murals, each measuring more than 25 feet long and almost 6 feet tall. The murals are located directly above the model ecosystems on both sides of the gallery. The mural in the Indian River Lagoon gallery shows a "bird's eye view" of the entire length of the lagoon, including its major cities (from Jupiter in the south to New Smyrna Beach in the north) and the five inlets that connect the waterway to the Atlantic Ocean. On the opposite side of the Aquarium, the mural depicts the change in bathymetry, or underwater topography, of the seafloor moving offshore from central Florida's east coast. The main features include the nearshore reef ecosystem, typically found in 15-120 feet of water, and the Oculina reef ecosystem, found approximately 25 miles offshore in around 300 feet of water.

The Aquarium is much like the environments it highlights - always changing - so plan your visit today! For more information: **www.sms.si.edu/SMEE**. SMS

Before (top left) and after (bottom left) the completion of the new IRL mural at the Aquarium.

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