The struggle between “weedy” organisms and “non-weedy” organisms has raged for eons. Many ecological communities are able to suppress weed invasions, while others succumb and suffer changes in community players, often resulting in altered stability and function known as a “phase shift.” While we commonly deal with nuisance weeds in our every day lives, many seaweeds pose a clear and present danger to fragile ecological communities, such as coral reefs. Kathy Morrow, a doctoral student from Auburn University, has recently joined Dr. Valerie Paul’s working group at the Smithsonian Marine Station to further investigate the interactions between weedy algae and common corals found in south Florida and throughout the Caribbean.

Kathy and Dr. Paul are particularly interested in the compounds produced by weedy algae to deter predation; chemicals that also compromise the health of corals and other marine organisms that occupy valuable real estate on coral reefs. Known as allelopathy, this ability to chemically defend and chemically compete can radically impact marine invertebrates that do not possess the innate ability to recover from such attacks. Corals do not have an adaptive immune system to protect against pathogens, but do harbor a select group of bacteria in their surface mucus layers that may help ward off attacks. Kathy studies these specific bacterial communities that reside on corals, and likens them to human gut fauna. As happens within our bodies, resident bacterial communities often change in response to the presence of harmful agents, such as viruses or chemicals. Kathy believes the change in a coral’s bacterial community that may be induced by algal chemical attacks may leave a coral susceptible to disease.

Kathy traveled to Carrie Bow Caye, Belize, in October to conduct an experiment on weedy algae interactions with corals. With the help of SMS research technician Raphael Ritson-Williams, Kathy exposed corals to the extracted compounds from the weedy algae Dictyota, Halimeda, and the cyanobacteria Lyngbya. She discovered that some of these algal extracts have antibiotic properties, while others stimulate certain bacteria within the coral mucus communities. With this knowledge in mind, she is currently using molecular techniques to fingerprint the corals’ resident bacterial communities before and after the exposures. Knowing how these micro-communities change will ultimately allow scientists and natural resource managers to better understand when corals are under sub-lethal stress.

New research suggests that some corals actively deal with weedy chemical attacks by passing on “good” bacteria to their progeny. Dr. Koty Sharp, a former Postdoctoral Fellow at SMS, has shown that the Mustard Hill Coral, Porites astreoides, transmits bacteria from one generation to the next. Kathy believes this transmission may give these corals a competitive advantage and thus a better chance at survival.
The tools of the trade for a marine scientist include more than just scuba tanks and wetsuits and are not commonly found on the shelves of the local department store. The most recent addition to SMS's repository of state-of-the-art scientific equipment is a Zeiss LM 510 confocal scanning laser microscope (CSLM). If the name alone conjures up images of futuristic sci-fi capabilities, then you are not far off. The key feature of the cutting edge microscopy is the use of a laser to scan through thick specimens section-by-section and produce clear digital images of both surface and internal structures. The information that is acquired and then reconstructed with specialized computer software provides three-dimensional views of structurally complex organisms. Researchers are essentially able to reconstruct an entire specimen.

Although CSLM technology originated earlier, it only became commonly available to universities and laboratories in the 1990s. SMS purchased a confocal system from Bio-Rad Laboratories in 2001 that was used by researchers and students to visualize cells and tissues, isolate the presence of chemical signals in organisms, and identify microorganisms. Advancements in CSLM technology have resulted in increasingly powerful microscopes that allow researchers to visualize objects as small as bacterial cells, a critical capability for the increasing number of SMS scientists investigating microbial communities.

Prior to her recent departure, former SMS Postdoctoral Fellow Koty Sharp utilized the new microscope, in combination with DNA sequencing, to visualize the location of bacteria on and in coral embryos. Symbiotic bacteria are often difficult to culture, so the ability to achieve results without growing the bacteria in the laboratory is essential. "These tools provide the only accurate methods for identification and localization of bacteria in marine animals," Dr. Sharp said.

But bacteria are not the only specimens that the new microscope has been focused on. Current SMS Postdoctoral Fellow Kate Rawlinson studies the evolution of polyclad flatworms by looking at early larval development. Access to the more advanced equipment has been invaluable to her work. The new confocal microscope has allowed Kate to inject the initial cell of an embryo with a fluorescent dye and trace it as it develops.

The purchase of the Zeiss confocal microscope was made in part with contributions by the Friends of the Smithsonian Marine Station. If you would like to learn more about this or other donor opportunities, please contact Valerie Paul at 772.462.0982.

With a collection of more than 80 million marine specimens (the largest in the world) and a vast network of marine scientists around the globe, the Smithsonian National Museum of Natural History’s (NMNH) newest exhibit, the Sant Ocean Hall, provides unparalleled insight and understanding of the global ocean. And amid the innumerable subjects that could and should be covered in the 23,000-square-foot exhibition, the Smithsonian Marine Station is highlighted for its research efforts along the Treasure Coast.

There are traces of SMS scattered throughout the Hall, including an image of a sipunculan in the Biodiversity Exhibit contributed by Director Emeritus Dr. Mary Rice. However, the most prominent representation of SMS – a field station of NMNH – is the 10’x10’ diorama of a typical Fort Pierce beach scene. While the preserved ghost crabs and snook are the most obvious tenants of the display, the true stars of the show are the meiofauna – the tiny organisms that live in the impossibly small spaces between sand grains. A roughly 90-second video highlights the extreme environment in which the microscopic organisms survive and the adaptations they maintain in order to do so.

Just as the meiofauna play a key role on sandy beaches, SMS is a vital part of the scientific environment at the Smithsonian and the staff are pleased to have contributed to the Sant Ocean Hall.

The Fort Pierce display provides a snapshot of life on local beaches, as well as some of the work conducted at SMS.
Flotsam and Jetsam

James Douglass is a Postdoctoral Fellow and a recent graduate of The College of William and Mary’s Virginia Institute of Marine Science where he earned his PhD studying seagrass food web ecology. James will continue to work with seagrass ecosystems at SMS, comparing characteristics both in and outside of no-fishing zones.

Andrew Gillis is in the last year of his PhD work at the University of Chicago, where he is studying the evolution and development of shark gills. During his stay at SMS, he is investigating the development of gill slits in hemichordate worms, which show similarities to those of primitive vertebrates.

Kathy Morrow is a PhD student at Auburn University where she is studying the interactions between corals, algae and microbes. While visiting SMS, Kathy will look into the effects of chemical extracts from algae and cyanobacteria on microbes that normally associate with corals.

SMS Welcomes Friends, New and Old
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. Members receive SMS News, invitations to lectures and special events, as well as additional benefits. For information on how to become a Friend, call 772.462.0977.


Mark Your Calendars: January-March Events

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<th>January</th>
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<tr>
<td>15th -</td>
<td>11th -</td>
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<tr>
<td>Research Station Tour</td>
<td>Storytime at SMEE</td>
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<td>21st -</td>
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<td>Storytime at SMEE</td>
<td>Breakfast with the Animals:</td>
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<td>23rd -</td>
<td>Mighty Minis</td>
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<td>SMEE Presents...</td>
<td>Morning Paddle on IRL</td>
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<td>Seagrasses</td>
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<td>29th -</td>
<td>Research Station Tour</td>
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<td>SMS Marine Science Lecture: Blue Crabs: New Science for an Old Fishery</td>
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<td>Teacher Workshop</td>
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<td>Teacher Workshop</td>
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For more information, including detailed program descriptions, times and cost (when applicable), please visit the Events Calendar page on the Exhibit website at www.sms.si.edu/SMEE or call the Education Office at 772.465.3271.

New Grants
Valerie Paul received an award of $209,595 from the National Institutes of Health (Subcontract from the University of Florida) for the project “Pilot-Scale Libraries of Marine Cyanobacterial Natural Products”.

Melanie McField received an award of $95,176 from The Summit Foundation for the project “Healthy Reefs for Healthy People.”

Valerie Paul received an award of $39,180 from the University of Florida/National Institutes of Health for the project “Activation of the Cancer Preventive Nrf2-ARE Pathway by Seaweed.”

Valerie Paul received an award of $204,800 from the Florida Fish and Wildlife Conservation Commission for the project “Research and Public Outreach Programs”.

Bjorn Tunberg received an award of $36,990 from St. Johns River Water Management District for the project “Benthic Infaunal Monitoring in the Northern Indian River Lagoon”.

Valerie Paul received an award of $25,500 from St. Johns River Water Management District for the continuation of the project “The Indian River Species Inventory: Critical Habitats and Associated Species”.

Bjorn Tunberg received an award of $23,000 from the St. Lucie County Mosquito Control for the project “Preliminary Study on Pollution Gradients in the Indian River Lagoon”.

Selected Publications


SMEE: Coming to a Computer Near You
Laura Diederick, Education Specialist

The model ecosystems at the Smithsonian Marine Ecosystems Exhibit (SMEE) have always allowed visitors the opportunity to get a fish-eye view of the underwater world without getting wet, and now that same privilege is available to marine enthusiasts world wide from the comfort of their own homes. The installation of the SMEE underwater webcams is finally complete and the results are fantastic! Virtual visitors can view the fishes in the coral reef and seagrass ecosystems and may even witness behaviors not seen by aquarium visitors.

“The animals in our model ecosystems are definitely aware when people are present,” said Marine Biology Educator Cristin Ryan. “Activity on the other side of the glass can affect how the fish and other animals inside the aquariums behave, so viewing them [via the webcams] without physically being there may lend itself to some unique observations.”

While the webcams may appeal to those simply curious to experience a “virtual” scuba dive, they can also be a strong educational tool, and not just for visitors to the site.

“We’re currently developing interactive features, as well as lesson plans for classroom teachers to use,” Ms. Ryan shared. “But we’re also looking forward to feedback from our virtual visitors. We hope that they’ll share interesting observations that we weren’t able to witness. We hope to be learning things from them!”

The project was funded by a grant from the Fort Pierce Redevelopment Agency and is the result of much collaboration between staff at SMS, the Smithsonian’s National Zoo and web technicians in DC. But the staff insists it’s a work in progress.

“There are so many possibilities,” Ms. Ryan continued. “We already have a third camera installed over a microscope in our laboratory that will be made available on the website in the next few weeks. And we’re looking for additional funding to purchase a fourth camera that would be installed on the roof of the exhibit and overlooking the Fort Pierce Inlet.”

The webcams can be accessed from the Ecosystems Exhibit website at www.sms.si.edu/smee. There is no special software needed, though some web browsers may require an additional download. If you have any questions, call 772.465.3271. SMS