Seafloor Characterization of the U.S. Caribbean
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Members of the ship crew during a fire drill.

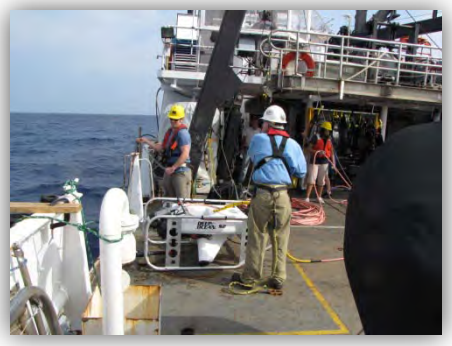
Day 1: March 18, 2010

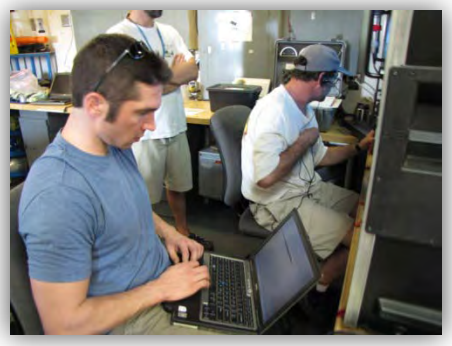
After a morning of double checking equipment and the standard NOAA ship safety drills, the ship crew and science team headed to a previously unmapped area northeast of El Seco. El Seco is an important reef area southeast of Vieques and a known tiger grouper spawning aggregation site. The team selected the study region using bathymetric and backscatter data that hinted at some unique seafloor features. And the findings did not disappoint.

"We saw extensive aggregate reefs and high live coral cover– some areas were as high as 50 to 90 percent," Bryan Costa, a geospatial scientist aboard the ship, said. "This is rare around the Caribbean where coral cover in shallow regions is low; in moderate-depth areas we've already studied, we usually see less than 50 percent cover," Costa said.

Finding corals and other biologically significant habitat types in the vast expanse of the ocean isn't quite like looking for a needle in a haystack. With the use of multibeam echosounders, the team can detect areas that may have unique features worth further exploration. The echosounders emit sound waves that bounce off the seafloor. Once processed they are used to create various images of the underwater landscape. To trained eyes, these images reveal distinct differences in habitat types– like if an area is covered in coral (a hardbottom habitat type) or sand (a softbottom habitat type).

To get an even clearer understanding of potentially important features around El Seco, the team deployed a remotely operated vehicle (ROV) equipped with special cameras to capture both underwater video and still images.





The ROV team prepares to deploy the machine off the side of the ship (left photo). Bryan Costa notes the seafloor characteristics as Lance Horn steers the ROV (right photo).

"The ROV is important because we aren't 100 percent sure what the structure is, nor are we certain what is growing on top of the structure until we collect the imagery with the ROV," Costa points out.

Today the ROV was deployed twice collecting about eight hours of underwater video. Real-time footage was displayed on two monitors and a large flat screen television in the labs. Along the way Costa and ROV operator Lance Horn snapped pictures and collected sediment samples to better understand the seafloor's characteristics.

As the machine traveled deeper and deeper jacks, tile fish and groupers quickly darted in and out of view. Several large barrel sponges and hard corals, like brain coral, also occupied the screen along the line of study.

DID YOU KNOW ...

- If all of the world's shallow water coral reefs were placed side-by-side, they would occupy an area a bit larger than the state of Texas.

- Coral reefs harbor more than one quarter of the ocean's biodiversity.

- Reef-building corals prefer clear and shallow water, where lots of sunlight filters through to their symbiotic algae. It is possible to find coral reefs at depths exceeding (300 ft).

For more information about coral reefs, visit:
http://coralreef.noaa.gov/

MEET THE SCIENTISTS ...

Tim Battista

Battista is an oceanographer with the Biogeography Branch and is the chief scientist for the mission. He is responsible for overseeing all scientific operations.

Bryan Costa

Costa is a geospatial scientist with the Biogeography Branch . His job aboard the ship is to conduct groundtruthing and habitat mapping.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit,
http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
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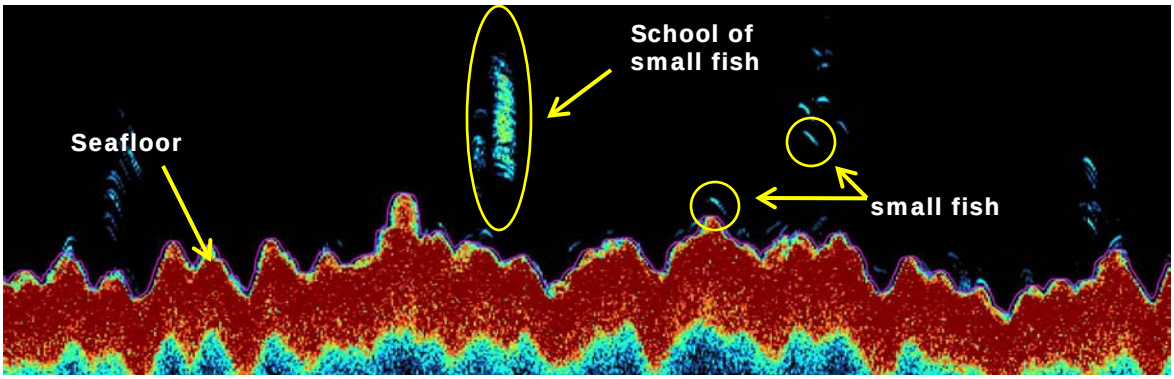
Day 2: March 19, 2010

Fish Acoustics
If you had to guess how scientists observe fish underwater, the first thing that might come to mind would be scientific scuba divers or underwater vehicles. But there's another, very effective tool at the disposal of fish scientists. Sound. Scientist having been using sound to study fish for over 30 years; within the last decade it has become an effective tool for researchers studying coral reef ecosystems.

The process is pretty simple. Pings, pulses of sound, are transmitted from a transducer bolted to the bottom of the ship. Roughly three to six short pulses of sound are emitted per second at 128 microseconds, a speed that is literally faster than a blink of an eye.

The pings reflect, or echo, off anything that has a different density than the surrounding water. The strength of the echo indicates the size and hardness of the object-- a large reflection would indicate a large fish.

Today Chris Taylor, an ecologist with NOAA's Center for Coastal Fisheries and Habitat Research, detected both large and small fish, as well as a few large schools of smaller fish. "We are waiting to see large schools of large fish, which would indicate a spawning aggregation site," Taylor said.



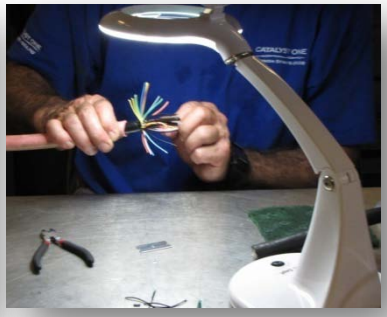
Fish acoustic technology does s suburb job of telling the size of individual fish and groups, but has limits where fish species identification is concerned. For example, species of similar size would have very similar echo returns, making them hard to classify using sound alone.

"This technology helps scientists find areas with high densities of fish so they can revisit them with divers, remotely operated vehicles and drop cameras," Taylor points out.

ROV Operations
The first run of the remotely operated vehicle (ROV) ran into a snag today when a portion of the 1,000 ft cable that connects the machine to the operating system brushed a rough patch of the seafloor. The screen immediately went black and an alarm sounded. ROV operators Lance Horn and Glenn Taylor quickly retrieved the machine. Closer inspection revealed a large tear in the thick pink plastic tubing near where the down weight was attached. Some of the delicate wires that power the ROV and control communication signals were damaged.

"We come prepared for this sort of thing," Lance Horn, ROV operations director from the University of North Carolina at Wilmington, said. "We had to remove about 100 feet of cable, but we will have the ROV up and running by tomorrow."

The eight-hour process to repair the cable required all the patience and skill of a surgeon, all while the ship rocked. First, layers of plastic and Kevlar and had to be carefully cut away to revel two bundles of multi-colored wires. Each of the wires were trimmed of the damaged sections and reconnected before being tested to ensure power flowed smoothly. Finally, the repaired wires were enrobed in a waterproofing substance and left to set and harden overnight.



ROV operators Lance Horn and Glenn Taylor begin the process of repairing and replacing the damaged ROV cable (left). Inside of the cable are many small copper wires. Damaged portions of the wires are removed from the cable before both ends can be reconnected (right).

DID YOU KNOW …

- In the U.S., coral reefs are found in the waters of the Gulf of Mexico, Florida, Puerto Rico, Hawaii and the US Virgin Islands , as well as the Pacific territorial islands of Guam, American Samoa and the Commonwealth of the Northern Mariana Islands.

- Coral reefs are in decline due to an increasing array of threats—primarily from global climate change, unsustainable fishing impacts and land-based pollution.

- The decline and loss of coral reefs have significant social, cultural, economic, and ecological impacts on people and communities in the US and around the world.

For more information about coral reefs, visit: http://coralreef.noaa.gov/

MEET THE SCIENTISTS …

Lance Horn

Horn is the operations director at the University of North Carolina, Wilmington's Undersea Vehicles Program. In addition to serving as a pilot and technician, he will oversee all ROV operations during the mission.

Glenn Taylor

Taylor is with the University of North Carolina, Wilmington's Center for Marine Science. He serves as the pilot and technician during ROV operations on the ship.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
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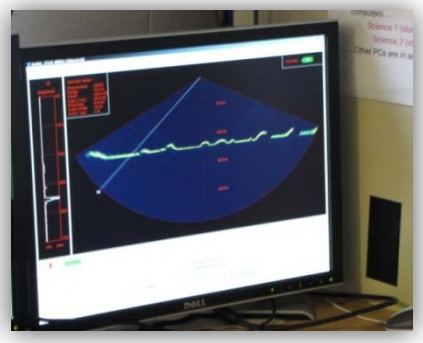
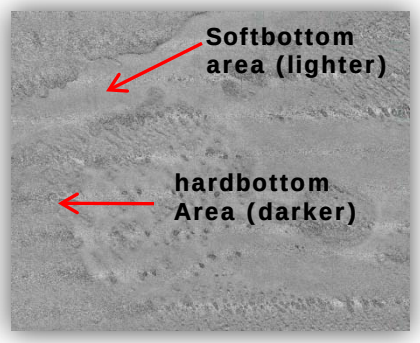
Day 3: March 20, 2010
Today scientists focused on an area south west of St. Thomas.

Multibeam Echosounders: Using sound to learn more about the seafloor
The NOAA Ship Nancy Foster is equipped with a new multibeam echosounder that sends out 512 beams of sound– called a SONAR swath-- at one time. The same basic principles of acoustic technology that apply to the fish acoustic system (see the March 19, 2010 log) apply to the multibeam echosounder, but the frequency of the multibeam unit is calibrated to provide information unique to the physical characteristics of the seafloor.

Based on the intensity of the echo returned after the sound waves reach the seafloor, scientists can determine an area's unique features as well as regions that are suitable for further study. The images produced reveal the physical characteristics, or bathymetry, of the bottom.





The multibeam echosounder (bottom yellow) as it is prepared for instillation (left). The bumps and ridges of the seafloor appear as a horizontal line on the screen (center). A backscatter image created from the multibeam highlights the different substrates on the seafloor (right).

Backscatter images created from the data show the intensity of the sound return, which tells researchers the type of substrate present and its roughness. For example, if the area is primarily made of mud, the return will be much less intense because the mud will absorb some of the sound wave's energy and lessen the echo. This shows up as a light spot on the image. Whereas an area covered with something hard, like corals, will deflect the sound waves rather than absorbing them, making for a more intense and darker characteristic on the image. Features with different roughness but of similar hardness also show up differently (hard and flat versus hard and rough). The SONAR swath can also detect objects passing though it in the water column.

In shallow water, like the survey areas for this mission, the swath covers a smaller area because it has less distance to travel, but yields clearer information. In deeper water, the sound waves have further to travel and can fan out over a larger area, but the echo returns are less distinct.

Marine Life Finds
The day got off to an exciting start when just as the ROV team was about to deploy for the first time, what looked to be a nurse shark was spotted off the port side of the ship. Crew and scientists alike quickly ran to snap photos. Not long after the shark swam out of view, it was spotted again by the ROV (Image 1). This time, the full size of the nurse shark was fully visible.

During the nearly four hours of ROV operations, a wide variety of marine life was encountered. An hour or so into the operation, a large hammerhead shark cruised by (Image 2).

Great star corals (Image 3), boulder brain corals (Image 4) and patch reefs teeming with fish were observed. The ROV also snapped photos of algae (Image 5). There were many sightings of marine debris like fishing line entangled in the reefs (Image 6) and abandoned fishing traps.

DID YOU KNOW …

- About half of the coral reef ecosystem resources under US jurisdiction are considered by scientists to be in 'poor' or 'fair' condition.

- Reef habitats adjacent to populated areas tend to experience more intense threat levels, but even remote reefs far from human settlements are imperiled by illegal fishing, marine debris and climate-related impacts.

- To learn more about the state of coral reef ecosystems across the U.S. and territories visit, http://ccma.nos.noaa.gov/ecosystems/coralreef/coral2008/landing.html and http://coralreef.noaa.gov/

MEET THE SCIENTISTS …

Chris Taylor

Chris Taylor is a research ecologist with NOAA's Center for Coastal Fisheries and Habitat Research. His job on the ship is to operate the fish acoustic s equipment and analyze the data during the first leg of the mission.

Mike Stecher

Mike Stecher is the lead hydrographer for the mission. He is responsible for multibeam data collection and data quality assurance.

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Day 4: March 21, 2010
Today scientists continue to focus on an area south west of St. Thomas, U.S. Virgin Islands

Ground Truthing
Once the multibeam data has been processed, scientists can use it to pinpoint unique acoustical signatures on the seafloor. Although the acoustic multibeam data provides a lot of information about the seafloor, it isn't readily apparent exactly what the acoustical signatures are. The only way to determine that is to visualize the seafloor with underwater video and photos to verify what the multibeam data indicate. This process is called ground truthing.

"Pre-existing multibeam data delineates unique seafloor features and in some cases we have a guess at what they are, but we're not always sure," Tim Battista, chief scientist for the mission said. "So the next step is to verify these unique acoustic signatures. And sometimes the only way do that is to take a picture of the bottom using a drop camera or a remotely operated vehicle."

Most of the places being mapped are too deep for divers. However, ROVs provide a way to accurately ground truth study paths up to 4 hours long and can be maneuvering to take pictures and video. For this mission, both the ROV and the drop camera will be used to ground truth. Just as it sounds, a drop camera is a video camera attached to a long cable that can be lowered off the side of a small boat to quickly determine what is present.

After fixing some electrical and mechanical problems with the launch, Sam Tormey and Tim Battista headed out for a day of drop camera ground truthing.

Tim Battista, Sam Tormey and ship crew member Gordon Pringle go out on the launch to begin ground truthing the area (left and center). Sam Tormey manages the drop camera and begins capturing underwater video.

Because of some pretty choppy waters, only about 20 sites were ground truthed in five hours. The team visited sites in the mapped area that were out too shallow to warrant use of the ROV. Using a GPS unit the boat driver came within 10 feet of a selected point. From there the drop camera was lowered to roughly three feet above the seafloor using an outrigger.

"I was surprised how well you can control where you are looking," Tormey said. "The camera has a line that feeds live shots to a viewing screen that Tim watches. He directs me on where to point the camer and zoom," he explained.

Although there are a lot of advantages to using a drop camera, there are also some disadvantages. Because of the wind and waves, it can be hard to put the camera in an exact point. Also, the camera can only go as far down as there is cable so the system is used in areas that are about 100-120 ft deep. "This is the first year we are using both ROV and drop camera to ground truth. Normally it's just one or the other," Battista said. "But we really wanted to take advantage of the ship's launch boats and its features that meet our ROV needs."

Derelict Fishing Gear

Fish traps are a common tool used by fishermen throughout the Caribbean. In the U.S. Virgin Islands alone it is thought that there are about 11,000 traps, with 1,000 in St. Croix and 10,000 collectively in St. Thomas and St. John spread though a variety of habitats. Problems arise when the traps are lost and cannot be easily recovered. In these cases, they continue to trap fish and can damage habitats as they are dragged over the habitat by waves, currents and storms. Just four days into the mission the ROV has captured many derelict fishing traps. Some are pictured below.

The Biogeography Branch and the National Park Service have partnered to study what impact derelict fishing gear is having on local fish communities in the U.S. Virgin Islands. Visit: http://ccma.nos.noaa.gov/ecosystems/coastalocean/derelictfishtraps.html for more information.

Derelict fishing traps observed with the ROV off the south west coast of St. Thomas.

DID YOU KNOW ...

•In the 2008 *State of the Reefs* report the U.S. Virgin Islands reported coral disease; climate change and coral bleaching; tropical storms; coastal development and commercial fishing as the top five threats facing the region's reefs.

• Other threats to corals that have been deemed important and relevant across all U.S. jurisdictions include: coral disease; tropical storms; tourism and recreation; vessel damage; marine debris and pollution; aquatic invasive species.

• To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov/

MEET THE SCIENTISTS ...

Ed Owens

Ed Owens is a physical scientists with NOAA's Atlantic Hydrographic Hydrographic Branch. He is in charge of nightime mulitbeam operations.

Sam Tormey

Sam Tormey is a marine spatial analyst with NOAA's Biogeography Branch. He plays a lead role in ground truthing operation s and provides support for multibeam data collection.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
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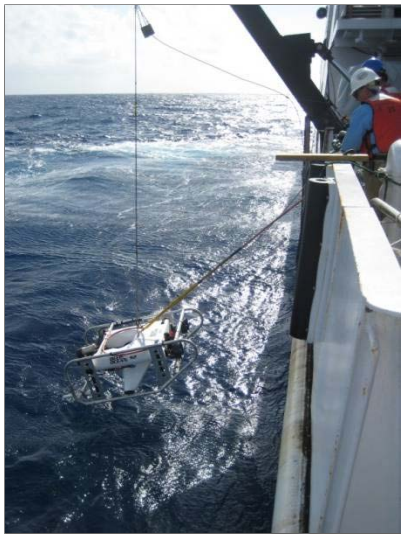
Day 5: March 22, 2010
Today scientists continue to focus on an area south west of St. Thomas, U.S. Virgin Islands.

The Day's Events
Due to some choppy water all small boat operations and drop camera activities were suspended for the day. However, the conditions did not affect the remotely operated vehicle (ROV) dives. The machine was deployed three times along three different study paths and captured some excellent video and still photos of different habitat types.

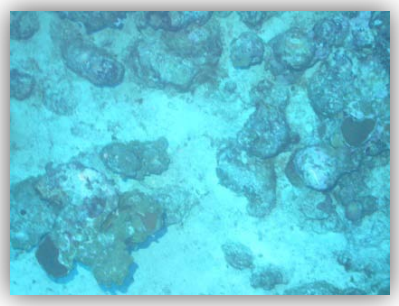

The ROV is retrieved from the water.

The first and most southern ROV dive revealed several different types of ground cover. The scientists saw aggregate reefs; spur and groove reef formations; areas covered by cylindrical algae covered calcified nodules called rhodoliths; and bare sandy areas.

There are many different kinds of habitats on the seafloor. The Biogeography Branch has established a detailed seafloor habitat classification guide its scientists use in the filed. Three of the main habitat types observed today are described below:

Aggregate reef formations
Vast expanses of coral formations that vary in shape and height, but lack the presence of sand channels are classified as aggregate reefs. They may also include linear formations of coral that grow parallel to the edges of the seafloor shelf. In this locale, this formation is typified by many plate corals, interspersed with a few soft corals and sponges. The reef space below the coral has many holes and cavities perfect for fish and invertebrates to hide in.

Spur and groove reef formations
A spur and groove reef consists of linear formations of coral that are separated by channels of sand roughly 5 meters wide. These formations are usually quite steep and are found at the shelf edge.

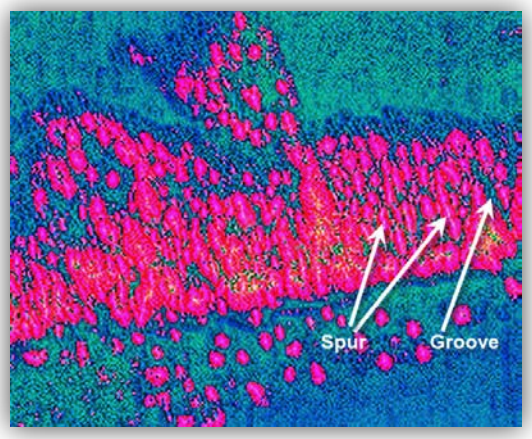

Aggregate reef formations (left), spur and grove formations (center) and rhodolith cover (right) were the primary seafloor cover types observed in the study region south west of St. Thomas.

Rhodolith-Covered Areas

Rhodoliths are round, hard calcified nodules that are roughly the size of a tennis ball. If an area of the seafloor is comprised of more than 10 percent rhodoliths, the habitat is classified as 'rhodolith'. Rhodoliths are colonized by thick layers of red algae. Because they are not attached to the seafloor, rhodoliths roll about in the currents and thus their distribution can change from year to year.

The second and third ROV dives were slightly northwest of the first dive. During dive two large expanses of aggregate reef, some rising an estimated 10-20 feet above the seafloor, were observed. The group saw one large yellow mouth grouper and a several schools of small fish, but very few large fish.

The final and most northern ROV dive exhibited vast aggregate reef formations, as well as spur and groove coverage. The spur and groove formations were also clearly detected on earlier multibeam images (see image below).



A spur and groove reef formation as shown by a processed multibeam backscatter image. The pink areas show reef spurs, the blue areas indicate grooves of sand.

For related information about the shallow and moderated-depth benthic habitats of St. John, U.S. Virgin Islands, visit: http://ccma.nos.noaa.gov/ecosystems/coralreef/benthic_usvi.html.

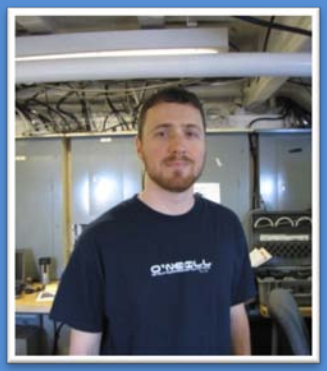
DID YOU KNOW …

•Coral reef ecosystems have many different values to people. Coral reefs
✓Are a source of food for millions;
✓Protect coastlines from storms and erosion;
✓Provide habitat, spawning and nursery grounds for economically important fish species;
✓Provide jobs and income to local economies from fishing, recreation, and tourism;
✓Are a source of new medicines; and
✓Are hotspots of marine biodiversity.

•Although it's difficult to put a dollar value on some of the benefits coral ecosystems provide, one recent estimate gave the total net benefit of the world's coral reef ecosystems to be $29.8 billion/year.

• To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov/

MEET THE SCIENTISTS …



Matt Wilson

Matt Wilson is a physical scientist with NOAA's Atlantic Hydrographic Branch. He assists with the hydrographic surveying and ensures that all data meet NOS standards.

MEET THE CREW …

Keith Martin

Keith Martin is the chief electronics technician aboard the NOAA Ship Nancy Foster. He keeps the ship's electronics, computers and sensors running.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
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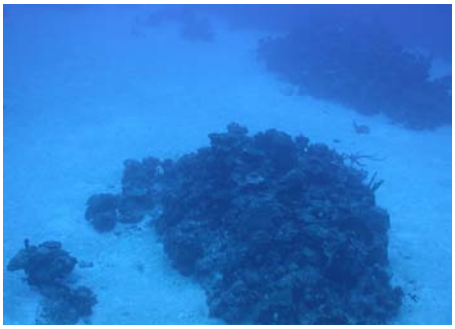
Day 6: March 23, 2010
Today scientists continue to focus on an area south west of St. Thomas, U.S. Virgin Islands. Remotely operated vehicle (ROV) dives were just northwest of yesterday's survey area.

The Day's Events
The first ROV dive of the day had to be cut short because a strong current from the south prevented operators from moving down the study path efficiently. The ROV was recovered from the water and deployed twice more at stations that were west of the original dive site.

During dive two, the team observed areas with variable coral cover– some areas along the study path only had roughly 10 percent cover while other exhibited 50-90 percent cover. Later, localized areas with upwards of 90 percent were seen.

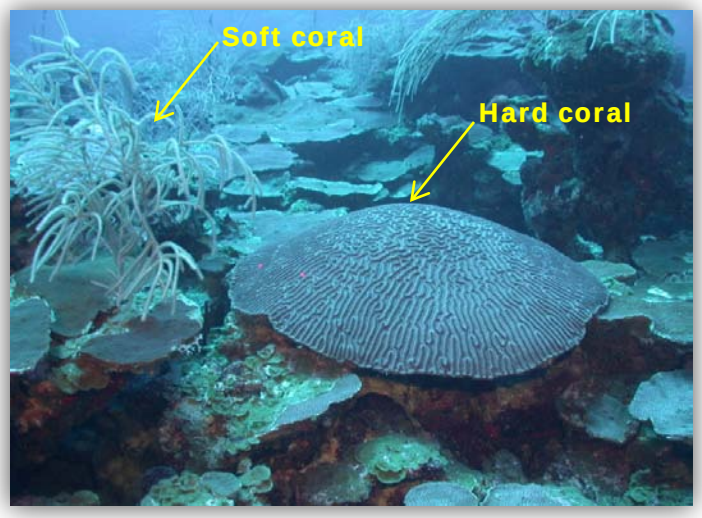
Once again, the seafloor habitats consisted of mostly of aggregated reefs, spur and groove reefs, bare sandy areas and hard pavement-like regions. The team also saw some patch reef formations. Individual patch reefs are usually circular or oblong in shape and can reach about a meter (3 feet) tall. These singular patch reefs are separated from other coral formation by sand, sea grass beds, rhodoliths or other habitat types that do not have much structure.

An aggregate reef about 125 feet under the surface. This reef exhibits high coral cover.



Individual patch reefs separated by sand.

Marine Life Finds
As the ROV cruised just above the seafloor, many different types of coral were spotted. There were many soft corals like sea plumes and sea whips drifting in the current. There were also plenty of hard corals like brain, encrusting and plate corals.



Picture of a reef with both hard and soft corals present.

Hard Coral
Hard corals are also know as scleractinian and stony coral. They produce a very hard skeleton from calcium carbonate extracted from the surrounding water. Hard corals are the primary reef-building corals. A good example of a hard coral would be the brain coral pictured to the left.

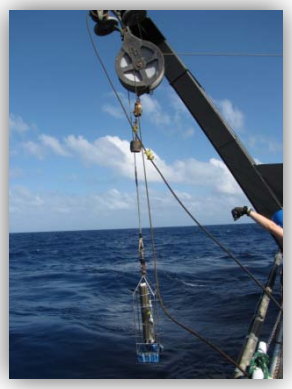
Soft Coral
Soft corals, on the other hand, do not produce a rigid outer skeleton from calcium and they are not reef builders. Soft corals almost look like swaying plants underwater (see soft coral to the left). Sea fans and sea whips are seen frequently on the underwater video.

CTD Cast

Just before every multibeam survey, senior survey technician Melody Ovard begins the process by casting a CTD. A CTD is an instrument that collects data on the water's conductivity, temperature and depth as it descends through the water column. Conductivity (a measure of the salt and other minerals present), temperature and depth are important chemical and physical characteristics to determine because they affect how the fast or slow the sound waves, or pings, emitted from the multibeam unit will travel to the seafloor and back. Sound waves travel 1,541 meters per second in water, six times faster than they travel in air.

As the ship moves along a study path Melody will cast the CTD at least every four hours because the chemical and physical characteristics of the water can change quickly as a result of waves, tides and other factors. The CTD will collect readings every half second as it navigates the 30-35 meters before stopping a just above the seafloor.

"If needed, I will do a cast at the beginning of a survey line and then again at the end," she said. "The chemical and physical characteristics can be very different from one location to another."



DID YOU KNOW …

•Corals can exist as individual polyps, or in colonies and communities that contain hundreds to hundreds of thousands of polyps.

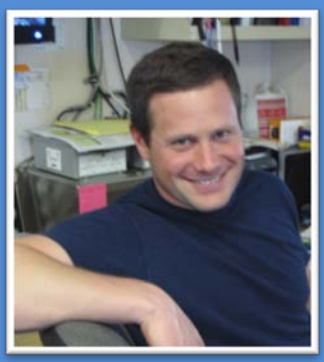
•Coral polyps are multicellular and their cells exhibit specialization to perform various functions.

• Corals exhibit very limited organ development. Corals have a gastrovascular cavity (simple stomach) that opens only on one end and a ring of tentacles.

•While most reef-building coral gain their yellow to brown shades of color from the symbiotic algae that live within their tissue, other corals contain protective pigments that give them bright colors.

• To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov/

MEET THE CREW …



Glen Rice

Glen is a NOAA Corps Lieutenant JG and team leader at the NOAA Integrated Ocean and Coastal Mapping Center. He is on the ship to expand habitat mapping data collection technologies to NOAA ships responsible for nautical charts.

Melody Ovard

Melody is a senior survey technician and dive master aboard the NOAA Ship Nancy Foster. She plays a key role in assisting science groups on the ship collect multibeam and other mapping data.

Seafloor Characterization of the U.S. Caribbean
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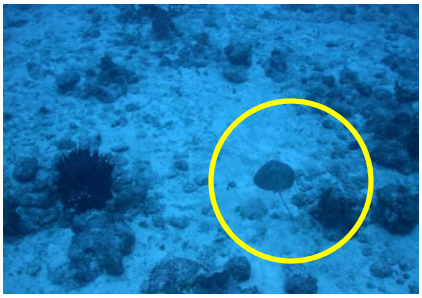
Day 7: March 24, 2010
Today scientists continue to focus on an area south west of St. Thomas, U.S. Virgin Islands. Remotely operated vehicle (ROV) dives were in the south eastern corner of the study area.

The Day's Events
The very first dive of the morning revealed some exciting marine life. Just minutes in to the dive a large shark was spotted in the distance. The scientists were unable to identify it at the time. Later a sting ray was seen gliding over the sandy seafloor surface. Three remoras hinted at the presence of another shark nearby. Several arrow crabs and shrimp were also seen. The area was dominated by high coral cover, with some spots having 50-90 percent coral.

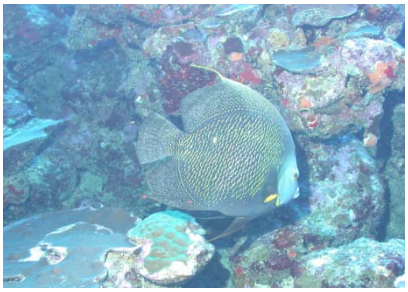


A sting ray swimming just above the seafloor is highlighted by the yellow circle (left). Soft corals like this sea whip were seen frequently (center). An close up shot of a star coral (right).

Dive two saw more soft corals than any other area to date. There were expanses of aggregate reef with high coral cover. In some areas coral mounds rose up above the reefs some 10 to 15 feet.

"The coral is more extensive than we thought, Bryan Coast, a scientists with the Biogeography Branch, said. "Most of the study area is reef punctuated occasionally by sand."

Fish
Unlike previous days, today the group encountered a number of fish. Angel fish, grunts, snappers, porkfish, ocean triggers and black durgeons were seen among the corals. The team also saw a few large tiger and yellow mouth grouper. Chris Taylor, a NOAA ecologist, points out that he hopes to see more grouper species after the full moon in early April when these fish will start to form spawning aggregation in certain areas.



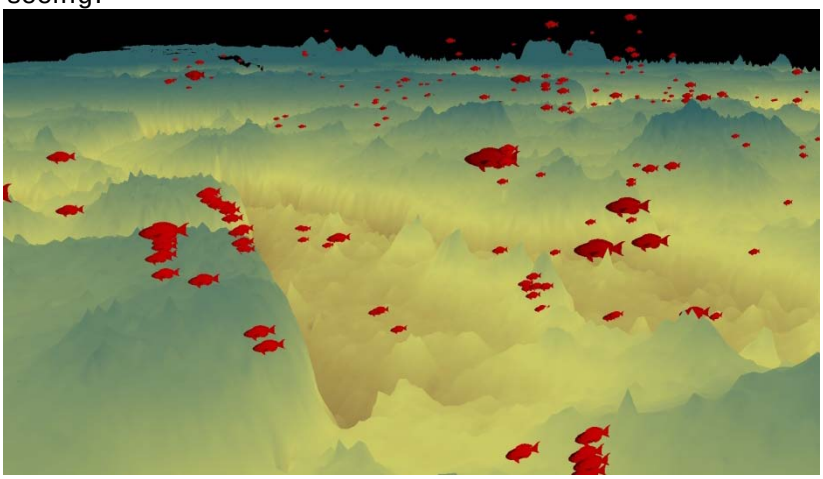
A queen trigger fish nestled in the coral (left). A whitespotted file fish swims by the ROV (center). A colorful angel fish (right).

"Up until now we just haven't seen that many fish in the transects we've been running. But that doesn't mean this whole area is lacking fish", Taylor points out.

Presently, the ROV is being used for ground truthing– to verify unique acoustical signatures on the seafloor pinpointed by the multibeam data. Thus the ROV is positioned to look down at the seafloor, often missing animals– like fish– that may be navigating the waters above or at the machine's side.

He points out that the fish observed so far have occurred where reefs meet sand channels and other flat, low relief areas.

"Some fish like to forage in adjacent flat bottom areas. Prey items could be in higher abundance there," Taylor explains. "This isn't always the case, but this is the pattern we are seeing."



A 3-D image illustrating the location & number of fish over the multibeam seascape. Notice how many fish occur near low relief areas. This image was created from fish acoustic data. Fish sizes are proportional, but not to scale.

DID YOU KNOW …

•Most reef-building corals have a mutually beneficial relationship with a microscopic unicellular algae called zooxanthellae that lives within the coral.

•The coral provides the algae with a protected environment and the compounds necessary for photosynthesis. In return, the algae produce oxygen and help the coral to remove wastes. Most importantly, they supply the coral with organic products of photosynthesis which are predominantly carbohydrates.

•Zooxanthellae often are critical elements in the continuing health of reef-building corals. About 90 percent of the organic material they manufacture Photosynthetically is transferred to the host coral tissue.

• To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov/

MEET THE CREW …

Angelito Llena

Angelito is the chief steward aboard the NOAA Ship Nancy Foster. Angelito is the lead chef aboard the ship responsible for three meals a day for the science team and ship crew. And they 're delicious!

Raul E. Quiros

Raul is a steward on the ship. He assists with the preparation of all meals for the science group and crew. He is also responsible for keeping the kitchen and dining area in working order.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 8: March 25, 2010

Today data collection activities began on the far west side of the survey area and ended in a southern portion of the area. Vieques, and island off the east coast of Puerto Rico, and Culebra were visible.

The Day's Events

Late yesterday evening the seas started to settle, clearing the way for morning drop camera activities aboard the launch boat. Over the course of the day the drop camera team collected ground truthing data at 47 sites in the mid-west portion of the mapped area south of St. Thomas. On average, the sites were roughly 130 feet deep. At each point GPS coordinates, percent coral cover and habitat type were typed into a mapping-quality GPS unit.

More than half way through the day the team collected video of a large nurse shark. "It followed us for a good ways," Tim Battista, research mission lead said. Battista also reported seeing a lot of fish at the sites.

Tim Battista and Chris Taylor head out for the second drop camera operation of the day (left). A crew member lines the launch boat up right next to the ship so the drop camera team can step in (center). Tim Battista reviews some of the drop camera video captured earlier in the day.

ROV Operations

The three ROV dives revealed much the same in terms of habitat– mostly aggregate reefs, aggregate patch reefs and spur and groove formations. "It looks like the reef continues westward further than we thought," Bryan Costa, a scientist with NOAA's Biogeography Branch points out.

Once again few animals were spotted during the ROV dives. However, the team did see some nice coral formations. Coral cover seemed to be more varied and a little lower on the western, more shallow sections of the survey area. The amount of coral ranged between 10 percent at some sites and as much as 90 percent at others. In the eastern portion of the study region coral cover remained consistently high. Overall these reefs in this area appeared to be in good condition.

Images collected during today's three ROV dives: (A) a reef fish; (B) a coral formation typical of what was seen during the day; (C) a sea fan; (D) a mix of plate corals and algae; (E) a shot of the underwater, coral-covered seascape.

DID YOU KNOW …

•Shallow coral reefs grow best in warm water (70–85° F). It's possible for soft corals to grow in places with warmer or colder water, but growth rates in these types of conditions are very slow.

•Reef-building corals prefer clear and shallow water, where lots of sunlight filters through to their symbiotic algae.

•Corals also need salt water to survive, so they also grow poorly near river openings with fresh water runoff.

•Mesophotic coral ecosystems, where the dominant habitat-forming species can be comprised of coral, sponge, and algae species, are found a depths between 30 and 150 m in tropical and subtropical waters.

• To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov/

MEET THE CREW …

Sean Cimilluca

Sean is the on-coming executive officer on the NOAA Ship Nancy Foster. When he takes the position in May, he will be responsible for carrying out the Commanding Officer's orders and managing administrative aspects of the ship.

Abigail Higgins

Abigail Higgins is the operations officer aboard the NOAA Ship Nancy Foster . Her primary role is to serve as a liaison between the science team and the ship's crew. She is also a deck officer and can drive the ship.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 9: March 26, 2010

Today the ship is headed back to Charlotte Amalie, St. Thomas where it will be docked for the weekend. On the way there the scientists and crew stopped to calibrate the fish acoustic transducer. Over the next few days a number of outreach and education events are planned, starting with a group of local fishermen touring the NOAA Ship Nancy Foster.

Calibration of the Fish Acoustics System

Just like a scale needs to be calibrated periodically to make sure it provides the correct weight, the fish acoustic transducer must be calibrated so the scientists know it is working properly and providing accurate data.

To calibrate the system divers attached a high precision sphere made of tungsten carbide (below) that has a known echo return to downrigger lines located at three different positions on the ship, creating a triangle. Divers hang the ball roughly 7-10 m below the transducer.

“Positioning the downriggers to create a triangle helps control the position of the ball and lets us move it around so we can observe it at many points in the transducer beam,” Chris Taylor, a NOAA ecologist studying fish during the first leg of the mission, explains.

Because the scientists know how far below the ship the ball is placed and they know its exact echo return, they can adjust the parameters of the system so that the results are consistent for every survey that is conducted.

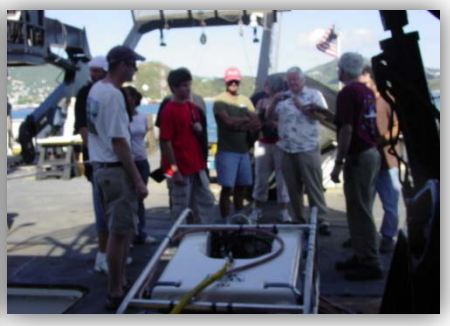
The tungsten carbide ball used to calibrate the system (left). Diver Kevin Adams prepares to assist with calibrating the fish acoustic transducer (center). Chris Taylor and Matt Wilson adjust one of the downriggers (left).

Local Fishermen Tour the NOAA Ship Nancy Foster

Shortly after the ship docked at the pier in Charlotte Amalie, a small group of fishermen and representatives with the St. Thomas Fishermen’s Association visited the ship and met with the scientists and crew on the ship.

Executive Officer LCDR Dan Simon gave the group a tour of the ship, taking showing them the bridge, the decks and the state rooms where the crew and science teams live while on board.

Next, it was time to explore the science done aboard the NOAA Ship Nancy Foster. Tim Battista gave the fishermen a brief overview of how the multibeam system works and how researchers use the data it to understand the features and habitats of the seafloor. Then ROV technician and operator Glenn Taylor explained how the ROV works and how the video data is used to verify what is seen on the backscatter and bathymetric images generated by the multibeam unit.



Tim Battista welcomes the fishermen on board (top left). Glenn Taylor explains how the ROV works on the back deck (top right). The group stops for a quick photo as they leave the ship (bottom left).

DID YOU KNOW ...

•Mesophotic coral ecosystems are characterized by the presence of light-dependent corals and associated communities found at water depths where light penetration is low.

•Mesophotic coral ecosystems are typically found at depths ranging from 30-40 m.

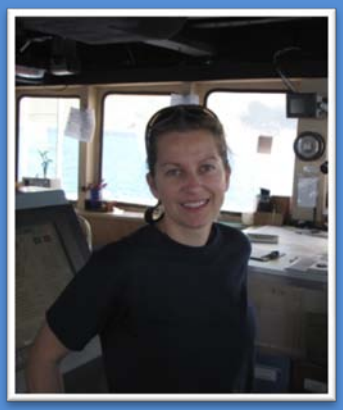
•The fact that they contain zooxanthellae and require light distinguishes these corals from true deep-sea corals, though their depth ranges may overlap

•Mesophotic coral ecosystems may be regarded as extensions of shallow coral ecosystems and often share common species.

• To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov/

CDR Ralph Rogers

Commanding Officer Rogers is responsible for all ship activities. The biggest parts of his job is navigating the ship, managing personnel and making sure science groups get the most out of their missions.



C. Mica Alex

Mica Alex , ENS, is a junior officer aboard the NOAA Ship Nancy Foster. In addition to being responsible for the safe navigation of passengers and property, Mica is also learning how to drive the ship.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 11: March 27, 2010
Today the group hosted a Kid's Day for local St. Thomas Youth aboard the R/V Nancy Foster. 27 5th graders and several of their teachers joined scientists to learn more about coral reefs and the work that will be completed during this research mission.

The Day's Events
It was an afternoon filled with lots of energy and excitement as 27 5th graders from the Gladys Abraham Elementary School boarded the R/V Nancy Foster. All of the students were from the school's Environmental Club, and though many of them already knew a lot about coral reefs, they were thrilled to learn more about the activities that occur on board that help us to learn about the corals around their island of St. Thomas. After a brief introduction about the days activities, the students visited three stations around the boat that aimed to orient them to the research mission underway.

Station 1 – Coral Reef Ecosystems:
NOAA Scientists Dr. Simon Pittman, and Maile Sullivan talked to students about coral reef ecosystems, their ecological and economic importance to islands like St. Thomas, the threats they face, and actions students could take to help protect them. After a brief presentation, students participated in an activity called "Build a Coral Reef" where they learned about connectivity between different reef species, and how human induced threats may disrupt important ecological connections within reef systems.

Dr. Pittman works with students to "Build a Coral Reef" ecosystem.

Station 2 – Research Tools:
Students met with UNC-Wilmington scientists Glen Taylor and Lance Horn to learn how coral scientists "groundtruth" (see Day 4 Log) some of the areas they map with the multi-beam sonar. After learning some of the basics about Remotely Operated Vehicles (ROVs), students enjoyed a demonstration of how Lance and Glen work together to operate the ROV, and saw examples of the detailed imagery that the ROV collected last week.

Students check out the Remotely Operated Vehicle (ROV), and all of its tools that help to explore the seafloor.

Students pose in front of the R/V Nancy Foster after an exciting day of activities on board.

Station 3 – Life on a Boat:
Perhaps considered the highlight of the day by many students, was the tour of the R/V Nancy Foster. Students got to check out the bridge, where the captain operates the ship; the state rooms, where the crew and scientists sleep; the "Mess", where many meals are shared; and even the video lounge, where folks on board can enjoy a little relaxation when they are not working! Students learned however, that life on board comes with its risks, and so being prepared for emergencies is extremely important. Edward Owens, from NOAA-Hydrographic Branch, had students practice safety drills, including a fire drill and an abandon ship drill. Getting on fire gear or a hypothermia suit in hot weather can be difficult, but the groups were up for the challenge!

Overall it was a great day! The students learned a lot, and had fun in the process. One of the students exclaimed as she left, "That was the best day EVER! Can we come back again tomorrow?!"

Thanks to all of the staff and scientists aboard the R/V Nancy Foster, and the school teachers who helped to make this event such a success!

Students practice putting on survival gear kept on board in case of fires (left) or abandon ship situations (right)

DID YOU KNOW …

• Corals can reproduce both sexually and asexually. During asexual reproduction, new polyps bud off from parent polyps to expand or build new colonies. This process produces polyps that are genetically identical to the parent polyp. Sexual reproduction occurs via broadcast spawning. About three quarters of all stony coral species broadcast spawn and produces male and/or female gametes that are released into the water column during spawning events.

• Whether you are a student working on a school project, a teacher looking for ways to incorporate lessons about coral into your classroom, or someone wanting to learn more about coral, many educational resources are available for you! Check out: http://coralreef.noaa.gov/education/

•http://coralreef.noaa.gov/

MEET THE SCIENTISTS …

Alicia Clarke
Alicia works with the Biogeography Branch and has been instrumental in the coordination of all of the education and outreach activities for this cruise, including NOAA Kids Day and the VIP/Media Day. Alicia also composed the daily blogs for the first leg of the cruise.

Tracy Gill
Tracy Gill works with the Biogeography Branch, and although she is not out for the at-sea portions of the cruise, she assisted with much of the coordination for the education and outreach events that occurred in St. Thomas.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 13: March 29, 2010

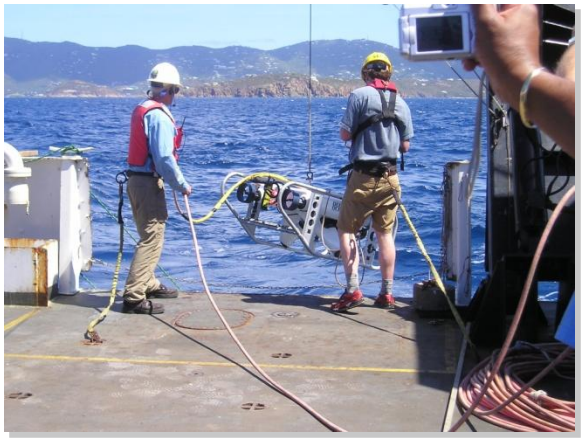
Today the scientists and crew hosted the 2010 Seafloor Characterization VIP Day aboard the R/V Nancy Foster. Several VIPs from around USVI and Puerto Rico joined the ship for a short cruise off of St. Thomas where they were introduced to some of the high-tech tools used to collect underwater data, and learned more about the mission and work involved in this cruise.

NOAA scientists Tim Battista and Mark Monaco from introduced the group to the goals and objectives of the Biogeography Branch's work in USVI, and how this work is helpful in informing managers and the decisions they make to protect coral reef resources. VIPs then spent time with NOAA scientists Edward Owens and Bryan Costa as they discussed their efforts in collecting data about the seafloor surrounding St. Thomas and St. John. Edward emphasized the importance of collecting data that provides information for multiple uses, or in his words,

"Ping once, and use many times." For example, data should be able to inform activities including nautical charting, archeology, marine geology, tsunami modeling, etc.

With the assistance of NOAA Scientist Sam Tormey, Lance Horn and Glen Taylor, from UNC-Wilmington, deployed the ROV over an area thought to contain corals south of St. Thomas. Though the expected coral was not present, visitors were able to watch as Lance navigated the ROV over a low relief area of seabed that contained algae, sponges, small rock outcroppings, and several small fish including red hinds, damsel fish, and squirrel fish. The ROV also flew by an old fishing trap and some of its associated fishing line.

Lastly, the group met with NOAA Scientist Laura Kracker, who talked about her upcoming fish bio-acoustics work she will be conducting on this leg of the cruise. The group finished with a tour of the ship led by LCDR Dan Simon and LT Abigail Higgins.



Glen Taylor and Sam Tormey demonstrate how the ROV is deployed.

Glen Taylor chats with volunteers from the Virgin Islands Environmental Research Station (VIERS) located on St. John.

Charlie Menza explains how the ROV will be instrumental in validating where fish and corals occur on the seafloor.

Mapping the Shelf's Edge

The ship spent the night mapping the edge of the shelf off of St. Thomas. We learned from some of the scientists that attended VIP day that the Virgin Islands are particularly excited about the mapping we are doing, as the shelf's edge is known to attract large schools of fish which are likely spawning aggregations. Information about important spawning aggregations can help them to inform decision makers about areas that may be needed to protect coral reef resources.

Charles Menza explained that until now, this part of the shelf is only mapped at a low resolution, whereas the high resolution mapping they are conducting will provide more accurate information about the presence of fish. They can then verify this information with acoustic surveys to ascertain more specific information about the location and density of the fish.
Furthermore, he states,
"Not only are we going to assess the aggregations that we know to exist, but we may even find new ones." This information is a high priority for coral reef managers.

Once the initial mapping of the shelf's edge is finished, the scientists will work together to determine the most effective areas to revisit and ground truth with the ROV.

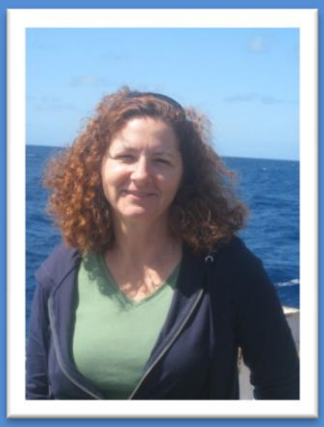
DID YOU KNOW …

• Species such as stony corals require free space to settle and grow. While this may sound easy in principle, free space – whether on the ocean floor or on top of another organism – is an extremely limited resource in the marine environment. As a result, species often compete with each other or exhibit aggressive behavior to secure or maintain a given plot of substrate.

• Sweeper tentacles are the most common defense mechanisms in the hard corals, and also occur in some soft corals. Specialized stinging cells called nematocysts are present in these tentacles and can attack a competing coral and literally burn it to the point of either killing it or severely damaging it.

•http://coralreef.noaa.gov/

MEET THE SCIENTISTS …



Laura Kracker
Laura works for NCCOS's Center for Coastal Environmental Health and Biomolecular Research in Charleston, SC. Laura will be running the fishery acoustic surveys on this cruise in order find out more about fish distribution within coral reef ecosystems and to find out more about spawning aggregations in St. Thomas and St John.

Charles Menza
Charles works for NOAA's Biogeography Branch in Silver Spring, MD. He is the chief scientist on this leg of the cruise and will be coordinating all of the science operations on board throughout the week. He is excited to learn more about the spawning aggregations off of St. Thomas' shelf edge through the mapping and fish acoustics work planned for this week.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 14: March 30, 2010

Two "budding" new scientists have joined the R/V Nancy Foster on the second leg of the mission this week. Karen Black and Kacey Johnson, both seniors at College of Charlston, joined the ship today to take advantage of an opportunity to work with scientists in learning more about the characteristics of the seafloor around the USVI.

Black and Johnson are both currently enrolled in a sea-floor mapping class at College of Charlston. Both geology majors noted that it is one of the few classes in this topic that exists for undergraduates around the country. The class offers an optional opportunity to participate in a mapping cruise during the semester – both girls jumped at the opportunity.

"We are learning how to process mapping data in our sea-floor mapping class, but I wanted to learn more about how the data is actually collected" says Black. Kacey Johnson agrees – "I wanted to gain more experience in this type of work." She adds that it will assist her in a project she is working on in with her professor, Dr. Harris, on deep-sea coral characterization (funded by NOAA Office of Exploration).

When asked if they are considering careers in marine science, both students agree that this experience aboard the R/V Nancy Foster will be instrumental in their future plans.

"I think this is really good experience that can be applied to any workplace. The skills we are learning aboard the ship will be something we can bring to the table in many different jobs" says Black. "I've wondered if working on a ship to do this kind of work is something I might do," Johnson adds. "I think this trip will help me to decide" (We're hoping an early bout of seasickness won't sway her decision!).

Karen Black (right) and Kacey Johnson (middle) learn about how to deploy the CTD from Melody Ovard, Nancy Foster Survey Technician (above); and work with NOAA Scientist Edward Owen on some multi-beam processing (below).

Both girls are interested in pursuing careers in marine geology. Karen is especially interested in structuring (plate) tectonics, specifically in mid-ocean ridges, however, she notes that she is trying to keep her options open. Kacey's interests are in marine paleo-biology, of which corals are an important component. Both agree that understanding multi-beam mapping technologies will be helpful to them in their future career paths.

While on board, Karen and Kacey will be processing multi-beam data that is collected on the cruise, as well as learning more about back-scatter data which will be new for both of them. We hope they will enjoy their time aboard

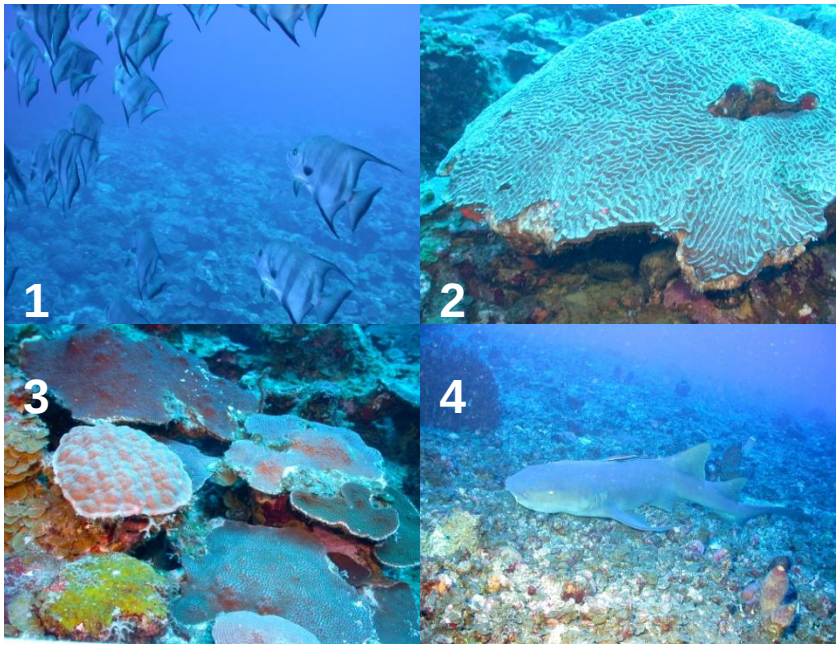
Today's Operations

Today's activities included multi-beam mapping continued to map the shelf's edge with the 10-02 sonar (deeper mapping capability), which outlines the studying area and identifies important hydrodynamic processes (such as channels that form deeper habitat) that occur there. Later in the day, two ROV dives were conducted along transects in the Red Hind Bank Marine Conservation District. Though one of the ROV dives had to terminate early due to a malfunction in the dynamic positioning system (the system that enables the ship to follow the transect), the dives showed high coral cover along the shelf, a variety of fish including grouper, ocean trigger fish, spade fish, damsel fish, barracuda and a few nurse sharks. Transects were selected by the team included areas previously mapped by USGS and by NOAA between 2004-09. The groundtruth data collected today will help to gain more comprehensive habitat information that includes the entire shelf region south of St. Thomas and St. John. One of the goals of studying these areas is to capitalize on existing mapping efforts to create a habitat map that pulls all of these existing data sets together.

DID YOU KNOW …

- While most reef-building coral gain their yellow to brown shades of color from the symbiotic algae that live within their tissue, other corals contain protective pigments that give them bright colors. Exposure to ultraviolet light (UVA and UVB) can destroy DNA, so some coral species dwelling in shallow waters have evolved protective pigments to reduce the negative effects of ultraviolet light. These pigments are often blue, purple, or pink and account for the bright colors found in some corals.

For more information about corals, visit: http://coralreef.noaa.gov/



ROV transects revealed moderate diversity of fish and coral species indicating a healthy reef ecosystem in the study area. 1)School of spade fish swims by 2)Large head of boulder brain coral 3)Several species of coral and some encrusting algae 4)A sedentary nurse shark on the sea floor.

Juan Torres

Juan is a professor at the University of Puerto Rico. Juan is interested in learning more about the multi-beam operations as they pertain to coral reef ecosystem research. He has been assisting the ROV team with species identification as they fly the ROV over transects.

Eric Ebert

Eric works for NOAA's Applied Ecology and Fishery Habitat Conservation Branch in Beaufort, NC. He is working on the fishery acoustics activities being conducted on the cruise.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 15: March 31, 2010

Anatomy of an ROV

Over the course of this expedition on the R/V Nancy Foster, we have made several references to Remotely Operated Vehicles (ROVs), and all of the detailed information our ROV has helped to gather about benthic and biological characterization of the surrounding seafloor. We've discussed why the ROV is important, in that it enables us to verify what organisms exist in some of the areas that are being mapped. But exactly what ***is*** an ROV? What components and features are required to explore places in the ocean that we as humans cannot go? Today, Lance Horn, an expert from UNC – Wilmington, talked to us about what it takes to be an ROV…

There are many styles, shapes, and types of vehicles used to explore the depths of the ocean. Manned submersibles, autonomous underwater vehicles (AUVs), and buoys are some of many ocean based tools used to learn more about the places that humans cannot work efficiently, based on our "underwater deficiencies." Until we grow a set of gills, these tools provide important capabilities that allow us to study the ocean. ROVs are one such vehicle used for ocean exploration, and are unique in that they require remote operation via a cable, or "umbilical" chord.

"The critical components that all ROVs must have to work are: a control console, an umbilical chord, and the vehicle itself" says Horn. "The structure of an ROV can be as simple or complex as you want, but they typically all need some sort of flotation capability, cameras, lights, thrusters, and a heading (compass) and depth sensor" he adds.

Parts of an ROV:

Electronics – the electrical wiring required to run the ROV capabilities is housed in the two cylinders on either side of the ROV structure. The heading and depth gauge is also contained here. Air space and syntatic foam housed in these cylinders provides buoyancy for the ROV.

Digital Still Camera – Takes digital pictures. Has zoom function, and is wired to the strobe light positioned above on the ROV structure.

Digital Video Camera – displays digital video imagery seen on control console screen and science station screen. Imagery can be recorded (see control console information). Small camera lights located above camera lens provide necessary lighting.

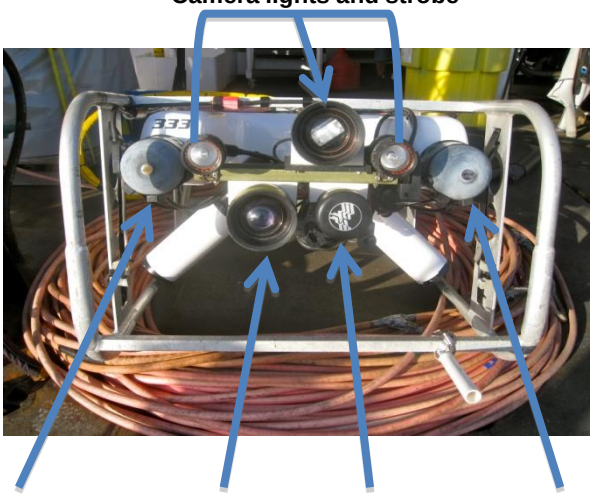
Lasers – projects two laser beams (10cm width) to provide scaling.

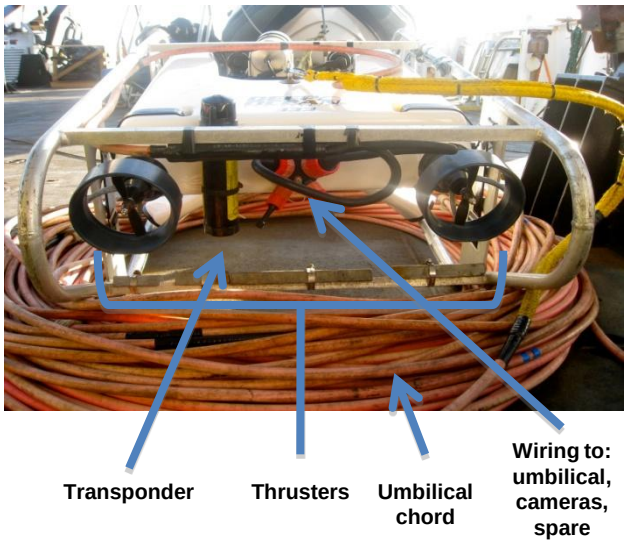
Transponder – used for acoustic tracking of the ROV's location (latitude and longitude).

Thrusters – two of four thrusters used for mobility (other two are in the middle of the vehicle and face different directions for increased pivotal movement)

Umbilical cable – transmits signals from the control console. The cable for this ROV is 900 ft long.

Wiring Port – attachment for umbilical cable, camera wiring, and spare apparatus attachments.





Depending on the ROV, their anatomy may differ from one to the next, depending on what type of work it will be used for. Thrusters, for example, which enable the up/down and side-to-side movement of the vehicle through the water column, can be mounted in various positions on the structure of the ROV, depending on how you want the vehicle to move around underwater. Similarly, materials used for buoyancy may differ – some use syntactic foam, where others may just use air-space in the structure.

The epicenter of an ROV in action is the control console – for this mission on the R/V Nancy Foster, this requires quite the set-up. This control console has a suite of dials and mechanics that allow scientists to gather the data they need to more accurately characterize the seafloor around the USVI. The console contains two major parts – the operational station, and the science station. The ROV driver uses the intricate system of computers, global positioning systems (GPS), video monitors, control dials and levers, and special software that integrates the ship's position with the ROV's position and the multi-beam data being collected, all to help steer the vehicle where its supposed to go! The science station has all of the video and still camera capabilities to record what is seen from the ROV during the dive. Scientists use this logged information not only to inform research efforts on the cruise, but also use this data for further scientific analysis once they are off the boat.

Parts of the Control Console:

OPERATIONAL STATION

GPS Tracking – identifies the location of the ROV in the water column.

Computer for tracking ROV and Boat – Uses Hypack software to track location of ROV in relation to the boat; can be integrated with bathymetric charts; aids in laying out transit line for boat to most efficiently collect data desired.

Screen to boat and ROV Tracking – Visual display of tracking system.

ROV Monitor – Displays video being captured by video camera on ROV and acts as view finder for ROV pilot.

Control Consol – Controls used to drive ROV (includes joysticks, thrust controls, etc.)

SCIENCE STATION

Microphone – Observing scientist uses for voice annotation of dive on video tape.

Video Overlay System – Records dive data on tape (date, time, location, dive series number, etc.)

Video Screen – Shows video imagery being collected on dive. Video can be recorded on DVD and tapes in console below.

Digital Still Screen – Control station for digital still camera. Can take pictures from here.

Operational Station

GPS Tracking

Computer for tracking ROV, boat

Screen to boat and ROV tracking

Monitor showing ROV dive

Control console: drive the ROV from here

Science Station

Microphone

Video Screen

Digital still camera

Video overlay system

The ROV aboard the R/V Nancy Foster for this research mission is a model Phantom S2, and is affectionately known as “R-O-V.” Lance has been working with this particular copper structured ROV for 23 years, and knows its ins and outs very well (all changes and repairs are intricately documented in her corresponding ROV manual). He notes that the utility of many ROVs is to be a “swimming eyeball,” and while that function is important, there are many enhancements that can make the tool even more versatile for conducting underwater research. For example, while “R-O-V” collects both still and video imagery, it has spare wiring capabilities that can attach tools such as manipulator arms, CTD samplers (conductivity-temperature-depth), and potentially even acoustic sonar, as they are needed for a given mission.

One thing that is abundantly clear about ROV operations aboard the R/V Nancy Foster, is the teamwork that is required to ensure a mission’s success. Lance’s right hand man is Glen Taylor, another ROV expert from UNC-Wilmington. The two have been working together on ROV operations for almost 20 years, and their expertise at this team effort is evident. They work seamlessly to operate the ROV from its deployment to its recovery throughout each dive. When asked why this particular ROV was the best for this research mission, Horn replies with a grin, “It’s not the ROV, it’s the *operators* that are best for this mission.” The duo has worked with Tim Battista, Principal Investigator on this project, for many years, and they are both known for their reliable and quality ROV operations. “The important thing is not necessarily the ROV itself, its what happens when it breaks!” Horn exclaims. Isn’t this the truth! (See Cruise Log Day 2: March 19, 2010).

Horn explains that while “R-O-V” has been enhanced over the years to conduct quality research, he has high hopes that there may be a new “shinier” ROV in his future. Fiber-optic frames and high definition (HD) imaging capabilities, among other new features will enable research at greater depths, and with higher resolution, which may prove useful for missions such as this one.

DID YOU KNOW …

- Deep-sea corals, also referred to as "cold-water corals," are a diverse collection of organisms that occur in deeper or colder oceanic waters. Unlike the well-studied shallow-water tropical corals, these corals inhabit deeper waters on continental shelves, slopes, canyons, and seamounts in waters ranging from 50 m to over 2,000 m in depth. Deep-sea corals lack symbiotic algae (zooxanthellae) characteristics of most reef building shallow water tropical corals.

- Unlike their shallow water relatives, which rely heavily on photosynthesis to produce food, deep-sea corals take in plankton and organic matter for much their energy needs. Deep-sea corals are also often extremely long-lived, slow growing animals, characteristics that make them particularly vulnerable to physical disturbance.

- http://coralreef.noaa.gov/

Glen Taylor deploys ROV for a dive (left); “R-O-V” sits aboard R/V Nancy Foster (middle); Lance Horn teaches Juan Torres how to drive ROV (right)

MEET THE CREW…

LT Dan Simon
Dan is the Executive Officer on the R/V Nancy Foster. He is responsible for carrying out the Commanding Officer’s orders and is charge of ship safety, personnel issues, and ship administration.

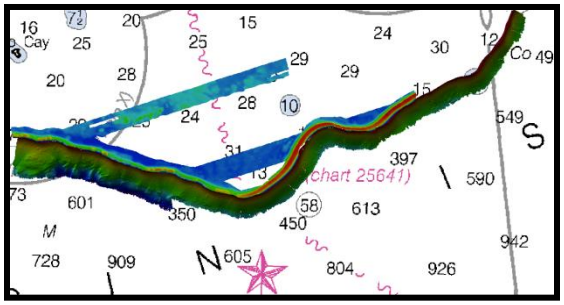
Jodie Edmond
Jodie is a Mate on the R/V Nancy Foster. She can drive the ship and is training to stand watch of the ship on her own.

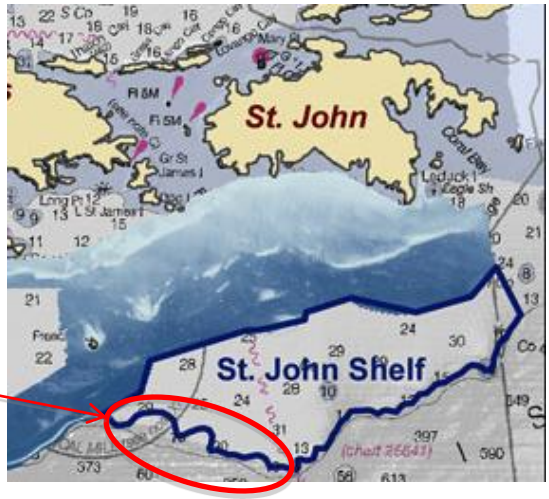
For more information about NOAA’s Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 16: April 1, 2010
Today data collection activities were conducted along the southwestern edge of the St. John Shelf study area.

The Day's Events
After a long night of multi-beam mapping along the edge of the St. John Shelf study area, the morning shift of scientists awoke to nice, calm waters in which to launch the ROV. Though there were tentative plans to deploy the small boat operations for some drop camera based groundtruthing, the team decided to focus today's efforts on three ROV dives. Scientists have spend the past two days working on transects on the St. John shelf, and along the shelf edge. Today the ROV was deployed for a total of 3 dives in this area. Additionally, fish acoustics surveys were conducted over two of these three transects.





The multi-beam team is starting to pull together draft maps (above) from the data they have been collecting on the south west edge of the St. John Shelf (right).

ROV Operations

The ROV dives today revealed fairly uniform substrate of pavement (hard substrate with little relief) and rhodoliths (see Day 5, March 22,2010 cruise log). The science team reports that there was moderate to high fish diversity as well as high coral diversity.

"Near the shelf's edge we saw lots of jacks, ocean trigger fish, and two sharks, which are things we don't typically see as much on the shallower reefs," remarks Charlie Menza, the Chief Scientist on the cruise. "We also saw the edge of the shelf which was really cool to observe because of it's geomorphology" he adds as he describes the experience of driving the ROV from the shelf, right over the edge. He explains, "It's like you are going along the reef and turn the corner and then it's totally black…" The ROV hovered over the edge a couple of times to check out the view into the abyss, but returned back to the stated course of the transects to gather the necessary data.

The fish acoustics team reported that they were excited to be able to follow the same transect lines as the ROV had, and were able to see presence of fish via acoustic sonar in most of the areas that the ROV documented fish diversity.

Images collected during ROV dives on 3/31 and 4/1:
(A) School of jacks; (B) a large sponge; (C) a few different coral species; (D) a sea anemone; (E) a very surprised Bigeye

DID YOU KNOW ...

- Unlike their shallow water relatives, which rely heavily on photosynthesis to produce food, **deep-sea corals** take in plankton and organic matter for much their energy needs.

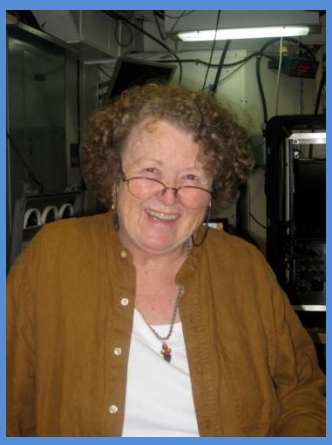
- Deep-sea corals are often extremely long-lived, slow growing animals, characteristics that make them particularly vulnerable to physical disturbance.

- Deep-sea corals may provide significant opportunities for advancing pharmaceutical and medicinal applications. For example, several deep water sponges—often associated with deep-sea coral communities—have unusual qualities that may potentially aid in the development of drugs for cancer, heart disease, and other medical treatments.

- To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov/

MEET THE SCIENTISTS ...

Samantha Allen
Sam is a Survey Technician on the Nancy Foster. Her Primary duties included working with the scientists to ensure that they have the technical assistance they need to complete their research.



Nancy Wright
Nancy works for the Olympic Coast National Marine Sanctuary in the state of WA. She has joined this research mission to learn some of the best practices for using the mapping capabilities that are being employed by the Biogeography team on this cruise.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

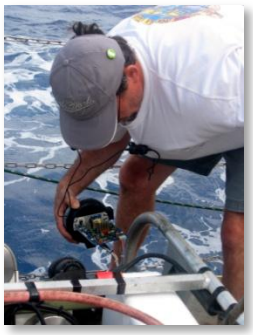
Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 17: April 2, 2010
Today data collection activities continued along the southwestern edge of the St. John Shelf study area. Both small boat operations and ROV dives were used to collect groundtruth data.

The Day's Events
After another full night of collecting multi-beam data along the southwest shelf of St. John, the small boat was launched and a couple of members from the science team traveled to 16 sites to survey habitat type with the drop camera. The ROV was also deployed on two dives to continue groundtruthing the shelf. We bid farewell to Edward Owens today, who had to travel back to the mainland for another commitment. Because it would have taken too long to take the Nancy Foster back into port in St. Thomas, the US Coast Guard picked him up in one of their small boats and delivered him safely back to Charlotte Amalie for us. The rest of the afternoon was filled with more multi-beam mapping and acoustic surveys.

The small boat gets launched for drop camera operations (above left; middle left); Science team members say farewell to Ed (above middle right); USCG transports Ed back to shore (above right)

ROV Operations
The ROV ran into some technical difficulties this morning during its first dive. Lance Horn and Glen Taylor went to work, and found the culprit: a broken washer. After performing a little ROV "surgery," it was ready to go back in for another dive.



Lance and Glen working on repairing the ROV

There were several exciting marine life encounters today, most notably two sightings of Staghorn coral (*Acropora cervicornis*), a threatened species of coral that is listed under the Endangered Species Act (ESA). Acroporids are structure forming corals, meaning they are important reef builders and provide important physical structure to reef ecosystems. Caribbean/Atlantic species of Acroporids, are comprised of Staghorn coral (*A. cervicornis*), Elkhorn coral (*A. palmata*), and Fused staghorn (*A. prolifora*), and were once prolific throughout the Caribbean, but have declined as much as 98% throughout their range since the 1980s.

The decline in this region can be attributed to several disturbances, both natural and human-induced. Coral disease, namely white band disease, has inflicted Staghorn corals throughout the Atlantic and Caribbean. Hurricanes, land-based sources of pollution such as run-off, increased fishing pressure and climate change are also major threats to these coral species.

The USVI is part of Acroporid restoration efforts taking place as a result of the American Recovery and Reinvestment Act. The goal of the project is to try and recover Acroporids by regenerating them in coral nurseries. Nursery-grown coral fragments will be transplanted to 34 reefs in eight distinct areas throughout Florida and the USVI where they will be monitored for success. For more information about this project please see:
http://www.nmfs.noaa.gov/habitat/restoration/restorationatlas/recovery_map.html

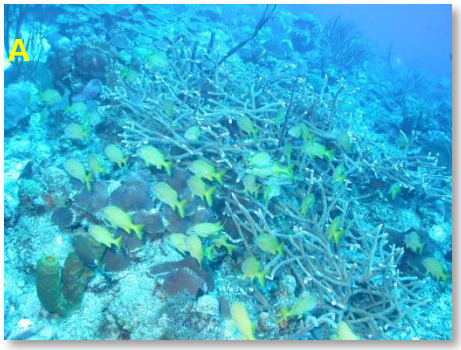
http://www.nature.org/wherewework/northamerica/states/florida/science/staghorn.html

DID YOU KNOW ...

- Staghorn coral, like many corals, receive most of their energy and oxygen from symbiotic organisms called zooxanthellae.

- Like counting rings in the trunk of a tree, the age of corals can be determined by examining coral growth rings.

- To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov/



Images collected during ROV dives on 4/2:
(A) School of grunts hang out near large stand of Staghorn coral; (B) close up shot of Staghorn coral; (C) another stand of Staghorn coral which is an endangered species; (D) a large lobster takes the ROV head on!

MEET THE CREW...

Kevin Adams
Kevin is the Navigation Officer on the Nancy Foster. He is responsible for preparing the track line for the ship to follow, and ensuring the ships safety where navigation is concerned. He has been aboard the Foster for almost 2 years. He will be rotating off the ship for a land assignment in Seattle in just a few months.

Steve Williams
Steve is "on loan" from the NOAA Ship R/V Rainier, while it undergoes it's midlife retrofit (a lengthy process that aims to prolong a ships life approximately 10-15 years). Steve works with the deck department on board the Nancy Foster. He helps with up-keep of the ship, and in this picture he is standing lookout watch.

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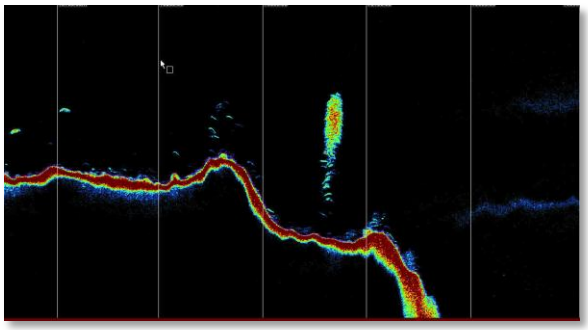
Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

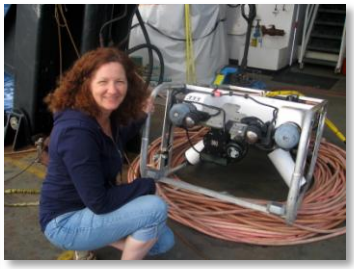
Day 18: April 3, 2010

Looking for Action:
While underway transiting west to Grammanik Bank, the crew and the science staff prepared for the moment we've all been waiting for (well, at least the moment the fish acoustic team has been waiting for)…spawning aggregations! Laura Kracker and Eric Ebert have been diligently working all week (along with ROV team Lance Horn and Glen Taylor) to fine tune the new equipment and software for an ROV retrofit that will enhance its sonar capabilities to account for fish aggregations…in the dark. Why, one might ask, are you trying to track groups of fish in the dark? Several species of reef fish, such as grouper, parrotfish, wrasses, snappers and surgeon fishes, form spawning aggregations. A spawning aggregation occurs when a large number of fish come together temporarily at specific sites to reproduce. Typically this behavior occurs at night. Seem simple enough? Maybe for the fish. Studying spawning aggregations from a scientist's perspective, however, is tricky business.

The first challenge to this science is knowing ***where*** to find the aggregation. Spawning aggregations tend to be predictable in location and time – often times they form at sites that are used year after year. It is important to understand more about these aggregations because they are thought to be the primary source of larvae that replenish reef fish populations.



The split scan sonar detects a "fish ball," or a group of fish on the shelf's edge.



Laura Kracker shows off the freshly installed high resolution sonar on the ROV (middle); the team waits patiently in the dry lab for an indicator that we have found an aggregation of fish (right).

Using existing data from local sources such as local researchers and fishermen can help narrow down the options of locations for scientists to start looking for spawning aggregations. Furthermore, using known life history and behavior information for the species being studied can help in determining where they might be congregating. In this case, we know that these fish species will often occur close to the shelf's edge and near open water, but in areas that have a reef close by. All the habitat mapping and groundtruthing information we've been collecting will come in handy in this context.

Another challenge to studying spawning aggregations is knowing ***when*** the aggregation will congregate. Luckily, for several reef fish species, this information is understood, at least within a temporal range. For example, the Yellow fin grouper (the fish that the team is trying to track on this mission) are thought to spawn 6-10 days after the full moon on an annual basis. The full moon was 6 days ago, so that is the cue to start our observations today!

So, if we know where these aggregations may occur, and we understand approximately when in the lunar cycle the event might take place, why have we yet to learn more about these aggregations? One of the major difficulties, logistically speaking, is that these events often occur at night. And, putting divers in the water at night to go look for a large group of fish whose location is hypothetical is like finding a needle in a haystack…blindfolded.

It's 7:45 pm and since lunch time, we've been using the acoustic sonar over a series of tight transects over the target range we've been told the Yellow fin grouper come to spawn. The plan is to deploy the ROV (with the new high resolution sonar capabilities) when the split-beam acoustic sonar indicates that we have found a large group of fish. The new high resolution sonar attachment on the ROV will use acoustic pings, much like those being used by the split-beam sonar on the bottom of the ship, to identify the size of the group of fish beyond what can be seen with the lights on the ROV (the lights will only illuminate about 6 feet in the dark).

No signs of any fish yet. The team hovers over the computer screens waiting for any sign of activity. "It's supposed to be 6-10 days after the full moon, so we may not have the right day, we may be early…" says scientist Eric Ebert. "So, if we don't see anything tonight, we'll try again tomorrow" he adds. But for now, they continue the search by having the boat continue over the same pattern of track lines with the split-beam sonar.

It's 9 p.m. and we have a sighting! The group confirms that it is in fact one lone Yellow fin grouper. It's not exactly an aggregation, but one fish is a start, right?

At 10:30 p.m. its time for me to turn in – but the science team continues to dive with the ROV in search of the mother-load of gravid groupers. The group continues through the night to dive along the transect of the shelf and the shelf's ledge where they have been surveying all day. Eventually they come across a larger group of fish, including approximately 15 Yellow fin grouper!

"It was a nice sized group of grouper, definitely not a spawning aggregation, but they looked nice and plump like they do before they spawn, so we are likely just off by a couple of days" remarks Ebert.

While the group will likely not be able to go back and survey this area again during this research mission, critical information was gained from this acoustic survey. First, it confirmed that Yellow fin grouper are indeed present at this site, so the site can be targeted for future studies. Additionally, Ebert explains that they learned that the track-lines they used as the survey course can help to identify where fish are moving within an area since they tracked the same course repetitively for 12 hours. Lastly, it was a good exercise using the high resolution sonar on the ROV to ensure that it works as a survey tool for this type of research. Tomorrow, the team will gear back up to look for more spawning aggregations off of a new site near St. John.

DID YOU KNOW …

• There are two main types of spawning aggregations:

Resident aggregations – Fish tend to live near the aggregation site and only have to travel a short distance to get to the site. Resident aggregations form on a regular basis and tend to be formed by smaller fishes such as wrasses.

Transient aggregations – Fish travel long distances to aggregation sites.

• Since spawning aggregations tend to be predictable in location and time, they are highly susceptible to overfishing. Fishermen are able to catch a large number of fish in a short time. Intense fishing on these aggregations can result in the disappearance of aggregations all together. The decline in spawning aggregations ultimately results in the reduction of the population because fewer and fewer fish are reproducing each year.

• To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov

The ROV comes across a Yellow fin grouper. The scientists were hoping to find a much larger group that would indicate a spawning aggregation.

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 19: April 4, 2010

Ensign C. Mica Alex didn't ever imagine she would be driving ships for a living. As a geophysicist and seismologist by training, sitting in a cubicle working on scientific algorithms had sort-of become her norm. But after about 10 years looking at a wall everyday, Alex decided she needed a career with a bit more adventure. And so she turned to the NOAA Corps.

"I wanted to work with something I could see, and something that affects people in every day life on a more direct scale" Alex explains. "I am really interested in doing coastal ecology and working with Sanctuaries" she adds, "I want to be able to educate people on the ground – something that will have an impact."

So just how does learning to drive a ship have anything to do with working "on the ground" with coastal ecology? Alex is a commissioned officer in the NOAA Corps. Most, if not all Corps Officers spend the first two years of their training on a NOAA vessel. The Officer candidates go through an extensive and rigorous training to become eligible to drive ships – including four months of basic officer training (BOTC) at the Merchant Marine Academy in King's Point, New York, two years on a NOAA ship, and 2 – one month long training academies that are interspersed through the 2-year ship time. At minimum, this must include 365 days at sea. All of this training qualifies Corps officers to take their U.S. Coast Guard License exams. And apparently the exams are quite the undertaking – there are 10 of them (!!!). Once an Officer has passed his or her exams, they are certified with a Mate 500/1600 License, which means they qualify to work as Mate on any ship up to 1600 tons (the Nancy Foster is approximately 800 tons).

Ensign C. Mica Alex (left) is in the process of learning how to drive the NOAA Ship Nancy Foster (above)

So why go through all of this training if you don't have your heart set on driving ships?

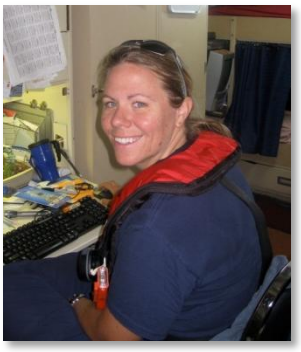
"I didn't join the Corps because I wanted to drive ships," Ensign Alex remarks. "The NOAA Corp opens the door for anyone with a Bachelor's degree in science to take their career to the next level. I can work as a scientist on land, in the sea, as a diver, or a pilot…the opportunities are endless" she continues.

After Officers finish their two-year ship time, most of them move on to multi-year land assignments. These assignments can vary, but range from working for NOAA regional offices and centers around the country doing science, to working in DC for politicals. So, for example, once Alex has completed her initial 2 years aboard the Foster, she can be placed in a position that allows her more exposure to coastal ecology issues and perhaps an opportunity to work with the Sanctuaries. But in the mean time, she's really enjoying her time on the ship.

"It's really, really cool," she says, "and very challenging." "I like learning how to steer the lines and make turns, all while you have to consider things like propulsion, and engineering. It gets really technical" Alex adds. She goes on to talk about the thrill of an always changing and dynamic working environment. She describes how at times, things are quiet on the ship, and how it can start to get a bit boring, and then within minutes it shifts to a high intensity bustle of activity where you have to be several steps ahead of the game to ensure that everything goes as it should.

Working with NOAA scientists aboard a ship requires a special skill set as well. Alex explains, "I've had to get extremely good at multi-tasking – there are constantly multiple screens to be read, radios going off, and weather conditions to contend with, all while you are trying to position the ship to allow the research activities to occur." She continues, "You really have to learn to think ahead because when you are in a reactive mode on a ship, that's never a good thing. It can be dangerous. You always have to be one step ahead of the game. Safety is our number one priority, but we do our best to get the scientists the data that they need."

The NOAA Corps consists of approximately 300 commissioned officers serving positions throughout the country, and is an integral part of NOAA and the Department of Commerce. Including Ensign Alex, there are five NOAA Corps Officers on board the Nancy Foster. Commanding Officer Rogers, Executive Officer LT Dan Simon, Operations Officer Abigail Higgins, and Navigation Officer Kevin Adams each also play a significant role in serving the mission of NOAA, and more specifically in ensuring the safe and successful research missions aboard the R/V Nancy Foster.



NOAA Corps Operations Officer Abigail Higgins hard at work. One of many responsibilities Higgins has is to act as a liaison between the scientists and the ships crew.

After being in the company of this group of Officers aboard the Foster, it is very evident that this is not a kick back, and cruise-the-seas for fun kind of job. These folks work extremely hard – and its not your typical 9am-5pm, Monday through Friday work week. Any time the ship is underway these folks are working. And, when they finish a long research mission and come in to port when a research mission is finished, and its not a weekend, they continue to work. Typically this group of Corps Officers are away from their home port about 8 months a year, living apart for extended periods of time from their families, friends, and with limited personal belongings. From a landlubber's perspective, it seems as though one sacrifices a lot for this job. And yet it is clear among this group, that they truly enjoy and are committed to being part of the NOAA Corps and on board the Nancy Foster.

"Sometimes when I am looking out while I am driving, and I see a pod of dolphins, or other wildlife, I think, wow, I'm getting paid for this!" Alex exclaims. "With this type of job, you have the opportunity to travel the world. The globe is the limit!"

Many thanks to all of the NOAA Corps Officers, and all of the rest of Nancy Foster crew for providing a safe, and successful research mission!

For more information about the NOAA Corps, please visit: http://www.noaacorps.noaa.gov/index.html

DID YOU KNOW ...

• Fishing impacts in coral reef areas, when ecologically unsustainable, has lead to the depletion of key functional fish species in many locations, with cascading impacts on coral reef ecosystems.

• Coral reefs are threatened by land-based sources of pollution that include sediment, nutrients, and other pollutants, originating from a variety of land-based activities, that are transported in surface waters, runoff, groundwater seepage, and atmospheric deposition into coastal waters. These pollutants can cause disease and death in sensitive coral species, disrupt critical ecosystem functions, cause changes in the structure and dynamics of the food chain, and impede coral growth, reproduction, and settlement of coral larvae.

• Climate change impacts threaten coral reef ecosystems by increasing ocean temperatures, storm activity, ocean acidification, and sea-level rise. These physical ocean changes lead to coral bleaching and diseases

• To learn more about coral reef ecosystems, visit http://coralreef.noaa.gov

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html

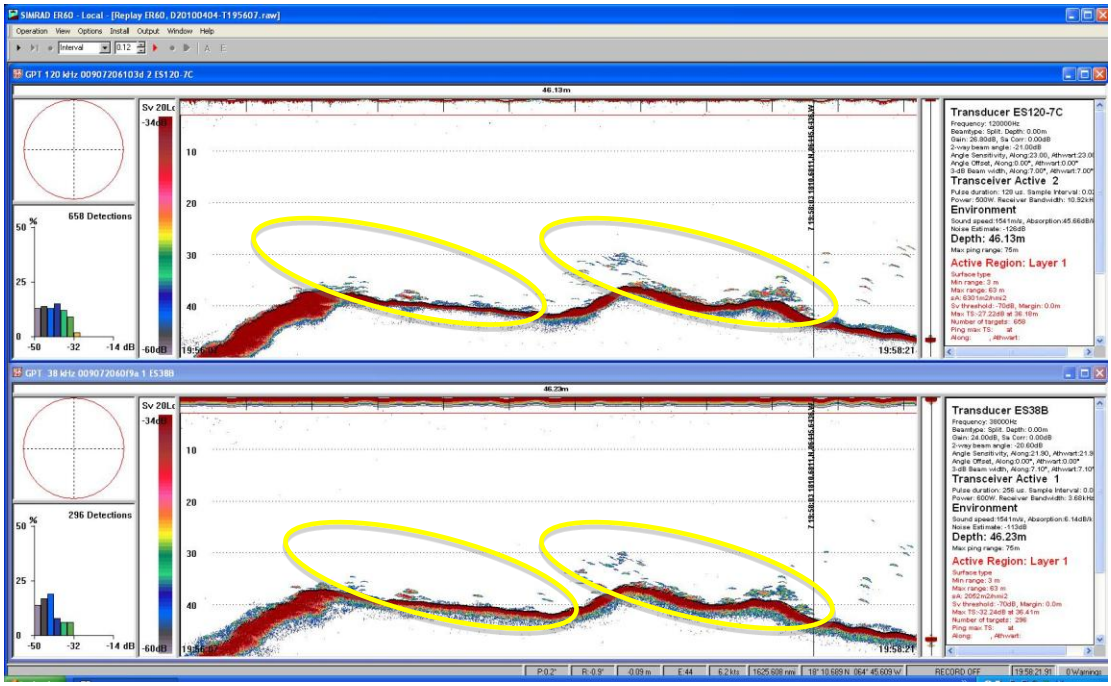
Seafloor Characterization of the U.S. Caribbean
2010 Field Season
March 18-April 6, 2010

Day 20: April 5, 2010
Today was filled with activity as the science team wrapped up the research that they have been working on for the past 20 days. Multi-beam mapping continued along the shelf's edge, an area that has indicated variable habitat types, and thus critical to attain accurate mapping data for. Fish acoustics work, ROV transects, and ground truthing with the drop camera collected last minute data before the science team had to pack things up to head home.

Fish Acoustics: The fish acoustics team worked last night and into this morning on acoustics surveys around Tampo Bank. They deployed the ROV early in the evening, and were excited to see a notable aggregation of fish at the onset of the dive. They saw several sharks, Yellow fin grouper, and a diversity of other fish species using the ROV. Unfortunately, the ROV became tangled in a line and had to be recovered early, terminating the ROV activities for the night. Though this put a damper on some of the fish acoustics work, they were still able learn important information about the area from their split-beam sonar.

"We found a lot of fish density and distribution along the SE ledge, at about 40 meters depth" reports Laura Kracker. "At around midnight, several fish seemed to congregate right at the tip of the shelf" adds Erik Ebert. "This work was useful, in that suggests to us that fish are consistently using this area over time" Kracker explains. "We confirmed that this is an important area for fish habitat use" Kracker explains.

The fish acoustics team also indicated that while using the high resolution sonar on the ROV, they were able to detect fishing traps, which may prove useful in locating derelict traps in the future. Additionally, Kracker mentions that in future research, they will likely utilize a stationary deployment of the high resolution sonar, so that they may capture presence of fish over longer periods of time.



The echogram from 120 khz transducer (top) and the 38 khz transducer (bottom) indicates that there are multiple schools of fish (in yellow circles) along this transect from the shelf's edge along Tampo bank (SW section of St. Johns Bank research area).

Small Boat Operations: A team took out one of the small boats this morning and completed groundtruthing at 22 sites with the drop camera. The team reported that they saw a big school of bar jacks on their first camera drop, and confirmed that the area they surveyed has a high coverage of rhodoliths, with limited coral coverage.

ROV Dives: The ROV team conducted two ROV transect dives along the St. John Shelf today. Glen Taylor, ROV operator, reported that they documented mostly patch reef, with scattered coral that appeared very healthy. He remarked that they came upon a small ridge that had an abundance of fish, including species such as yellow-tail snappers, grunts, etc.

Wrapping Things Up: Scientists and crew spent the afternoon wrapping up their research, and packing up all of their tools and gear – an effort that was quite an undertaking! Divers got into the water to remove Reson multi-beam sonar, which was bolted to the bottom of the ship, while staff and scientists on board packed up ROV equipment, wrapped up cables, and boxed computer screens. The team will continue to multi-beam map the St. John Shelf's edge tonight, but will do so with the 1020 sonar, which provides a lower resolution, but deeper mapping capabilities.

(A) *Montastraea cavernosa*, found on the ROV dive; (B) A trunk fish hovers above rhodoliths; (C) Two Rock Beauties forage on the reef; (D) Scientists pack up gear; (E) Diver jumps in water to remove the multi-beam sonar from the bottom side of the ship; (F) Crew pack up the sonar once its aboard the ship.

MEET THE CREW…

Ben Nolan (left) is a Deck Utilityman, **Greg Walker** (middle) is Chief Botswain and **Derrick Williams** (right) is the Oiler on the Nancy Foster.

Several more crew work aboard the ship, but we've run out of days! Thanks crew for a great cruise!

Maile Sullivan
Maile works for NOAA's Coral Reef Conservation Program in Silver Spring, MD. She has been responsible for the cruise logs and communications during the second leg of the cruise. Thanks for reading!

For more information about NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch visit, http://ccma.nos.noaa.gov/about/biogeography/welcome.html