

2013 RESEARCH AND MONITORING REPORT



May 2014

The purpose of this document is to report the activities of the Flower Garden Banks Research Team during FY2013.

National Oceanic and Atmospheric Administration

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Cover Photo

A squadron of Devil Rays (*Mobula tarapacana*) glide past divers during their safety stop at West Flower Garden Bank. Two species of mobulid rays have been reported at FGBNMS – the other being the Lesser Devil Ray (*Mobula hypostoma*). Both are rarely sighted compared to the Manta Rays which are seen regularly by divers. Image credit: Hickerson/FGBNMS



ACRONYMS

B.E.S.S. – Biological Environmental Sampling Systems
BOEM – Bureau of Ocean Energy Management
BOEMRE – Bureau of Ocean Energy Management, Regulation, and Enforcement
BSEE – Bureau of Safety and Environmental Enforcement
DAS – Days at Sea
EPA – Environmental Protection Agency
F.E.T. – Forum Engineering Technologies
GIS – Geographic Information System
CIOERT – Cooperative Institute of Ocean Exploration, Research and Technology
CRCP – Coral Reef Conservation Program
DSCRTP – Deep Sea Coral Research and Technology Program
EFGB – East Flower Garden Bank
FDA – Food and Drug Administration
FGBNMS – Flower Garden Banks National Marine Sanctuary
GOM – Gulf of Mexico
GRNMS – Gray’s Reef National Marine Sanctuary
HBOI – Harbor Branch Oceanographic Institute
HD – High Definition
LUMCON – Louisiana Universities Marine Consortium
MMS – Minerals Management Service
MOCNESS – Multiple Opening/Closing Net Environmental Sensing System
NAZ – No-Activity Zone
NCCOS – National Centers for Coastal Ocean Science
NCDDC – National Coastal Data Development Center
NMSF – National Marine Sanctuary Foundation
NOAA – National Oceanic and Atmospheric Administration
NWGOM – Northwestern Gulf of Mexico
ODMDS – Ocean Dredged Material Disposal Sites
ONMS – Office of National Marine Sanctuaries
OSU – Oregon State University
PSBF – Potentially Sensitive Biological Features
ROV – Remotely Operated Vehicle
SCUBA – Self Contained Underwater Breathing Apparatus
SEFSC – South East Fisheries Science Center
SPI – Sediment Profile Imaging
TAMUG – Texas A&M at Galveston
UNCW – University of North Carolina – Wilmington
UT – University of Texas
UVP – Underwater Vehicle Program
WFGB – West Flower Garden Bank

Overview

The FGBNMS research team was involved in 13 research cruises and expeditions during the 2013 field season. The R/V MANTA was utilized by the research team for a period of 58 days to conduct operations. A pool of 41 sanctuary personnel, scientists, and reciprocity divers conducted 489 SCUBA dives during the 2013 field season. Activities included biological surveys and sample collection, removal of invasive species, equipment maintenance, and image collection. Seven sanctuary permits were processed, and an additional six were/are ongoing. The FGBNMS Sanctuary Superintendent permit was utilized to install long-term monitoring stations and sight pins, sample corals for species identification, and remove invasive species. A coral identification guide was finalized by Dr. Tom Bright and FGBNMS.



A sculptured slipper lobster (*Parribus antarcticus*) out and about during coral spawning 2013. Image credit: FGBNMS/G.P. Schmahl

FY 2013 HIGHLIGHTS

TAMUG SCIENTIFIC DIVING FGBNMS SPECIALTY CLASS

The Flower Garden Banks National Marine Sanctuary research team developed a program specifically to train Texas A&M University at Galveston (TAMUG) Scientific Divers in fish and coral identification and survey techniques. This was the inaugural session of the FGBNMS/TAMUG specialty course. The course included several classroom sessions, a pool session at TAMUG, and fish identification/survey practice at Moody Gardens Aquarium. Classroom sessions included introduction to FGBNMS, long-term monitoring, fish and coral identification, and survey techniques. During one of the pool sessions floating fish outlines of different sizes and colors were placed in the pool for the students to practice a fish survey.

The goal of the course is to develop a pool of knowledgeable American Academy of Underwater Sciences (AAUS) reciprocity divers FGBNMS can draw from to assist in long-term monitoring activities at the sanctuary. This course will be offered once a year to the TAMUG Scientific Divers on a voluntary basis. Incentive for the TAMUG divers is to become involved in research at the sanctuary, and gain real life experience in their field of interest. The students are also encouraged to get involved in other FGBNMS activities such as Ocean Discovery Day and remotely operated vehicle (ROV) cruises.



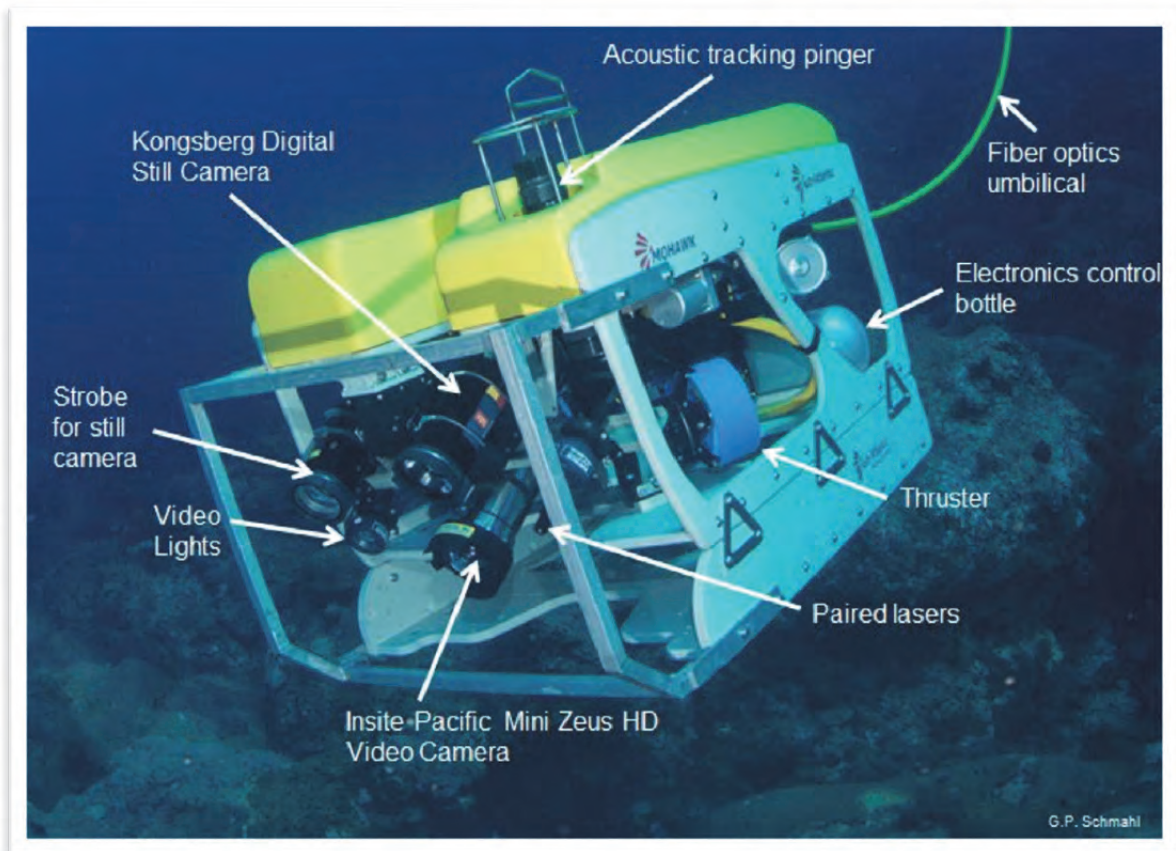
TAMUG students from the inaugural FGBNMS Specialty Class practice fish survey techniques in the pool and at Moody Gardens. Image credit: T. Hennessy and FGBNMS/John Embesi

2009/2010 EAST AND WEST FLOWER GARDEN BANK LONG-TERM MONITORING REPORT DRAFT

Prior to 2009, FGBNMS Long-Term Monitoring for East and West Flower Garden Banks was conducted by contractors who completed both the field work and writing the report. In 2009, FGBNMS took over the data collection and report writing in partnership with MMS/BOEMRE/BOEM. The first report compiled with this new arrangement was completed in 2013, led by Dr. Michelle Johnston. The report was finally released in March 2014.

NATIONAL MARINE SANCTARY FOUNDATION (NMSF) AND FGBNMS TAKE DELIVERY OF AN F.E.T. "MOHAWK" SCIENCE CLASS REMOTELY OPERATED VEHICLE

NMSF and University of North Carolina-Wilmington (UNCW) representatives traveled to Aberdeen, Scotland to take delivery of the newly acquired F.E.T. "Mohawk" Science Class ROV. The vehicle was shipped to Houston, and the inaugural cruises were conducted in the sanctuary in October 2013. This ROV replaces a system that was maintained and operated by UNCW.



NMSF/FGBNMS F.E.T. "Mohawk" ROV photographed on the reef crest during the inaugural cruise in October 2013. Image credit: FGBNMS/G.P. Schmahl

This ROV has been built with 300m capabilities, but can be upgraded to a 1000m depth rating. The system will provide enhanced visualization through HD cameras, increased sampling capabilities, and an upgrade to fiber optic umbilical technology. A custom collection carousel/tool skid will be designed and built by Harbor Branch Oceanographic Institute (HBOI). The NMSF and UNCW have developed an agreement so that NMSF maintains ownership of the system, while UNCW operates and maintains the new system, which will be available as a regional asset for the ONMS/NOAA programs. Full ROV specs here: <http://flowergarden.noaa.gov/science/mohawkrov.html>

POTENTIALLY SENSITIVE BIOLOGICAL FEATURES (PSBF) FIELD WORK COMPLETED



Giant Caribbean sea anemone (*Condylactis gigantea*), Sunshinefish (*Chromis insulata*), and Pederson cleaning shrimp (*Pereclimenes pedersoni*), and coralline algae at around 250ft depth at East Flower Garden Bank – still image from HD video from Mohawk ROV.

FGBNMS and partners, Louisiana Universities Marine Consortium (LUMCON), and UNCW-Underwater Vehicle Program have completed field surveys at fourteen reefs and banks in the Northwestern Gulf of Mexico. The project was initiated in 2011 and the first surveys were conducted in October 2011. The seventh, and final, cruise was conducted in June 2013. The study aimed to characterize habitat that falls outside of BOEM's currently designated No Activity Zones (NAZ) with the aid of high-resolution bathymetric data.

A remotely operated vehicle provided by UNCW-UVP was used to explore and document these locations, collecting images that will be/have been analyzed to help characterize habitat diversity. The study sites included 28 Fathom, 29 Fathom, Alderdice, Bouma, Bright, Elvers, Geyer, Horseshoe, McGrail, Parker, Rankin, Rezak, Sidner, and Sonnier Banks. Data collection is complete, and the FGBNMS research team has processed over 6700 images for statistical analysis. The processed image data has been passed along to LUMCON for analysis. FGBNMS will assist in the report writing efforts for the project. Visit the various banks here:

http://www.ncddc.noaa.gov/website/google_maps/FGB/mapsFGB.htm



Bryozoan photographed using Mohawk ROV still camera in mesophotic depth ranges.

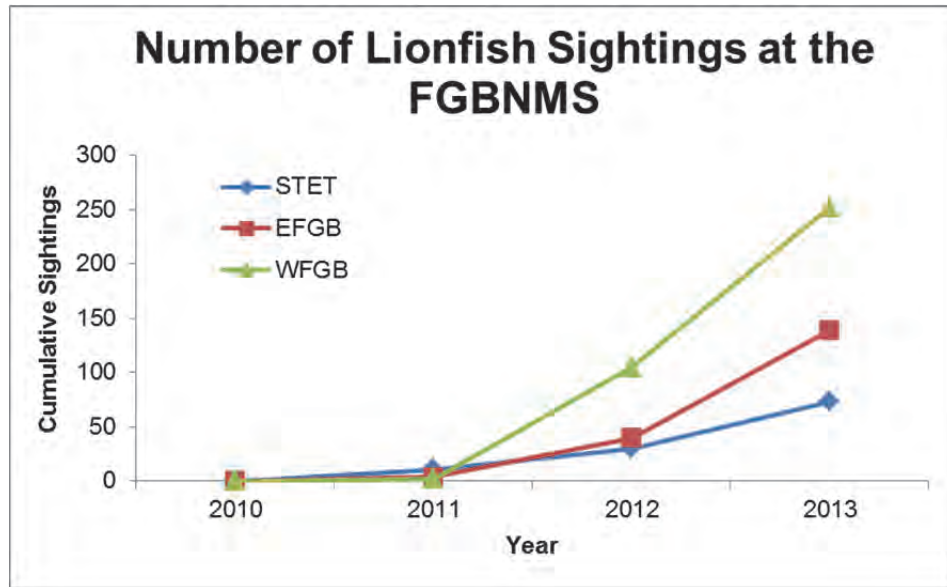
FGBNMS CONTINUES TO TRACK AND RESPOND TO LIONFISH INVASION

Lionfish were first captured in the southern Gulf of Mexico (GoM) off the northern Yucatan peninsula in December 2009. In September of 2010, two Lionfish were sighted at Sonnier Bank by TAMUG researchers. This was the first confirmed sighting of Lionfish at the natural banks in the Northwestern GoM, about 60 miles east of East Flower Garden Bank. The first Lionfish report in the sanctuary came from recreational divers at West Flower Garden Bank the week of July 20, 2011. On July 27, 2011 photographic evidence was provided by a separate group of divers at Stetson Bank. To date, a total of 1,078 Lionfish have been observed around the NW GoM banks and surrounding oil and gas platforms, and 656 of those Lionfish have been observed in sanctuary waters. Of the Lionfish observed within FGBNMS, 327 have been removed for genetic analysis in partnership with the NOAA Laboratory in Beaufort, NC, and Texas A&M—Corpus Christi. The Lionfish that are removed are being dissected for gut content analysis, to identify which fish are being targeted as prey at FGBNMS. To date, the most common identifiable gut contents include crustaceans (34%), wrasses (13%), blennies (5%), and damselfishes (4%).

Sanctuary staff are tracking the invasion at FGBNMS and surrounding banks by documenting the locations of Lionfish removals and observations. These observations include sightings during ROV surveys in deepwater habitat. Through the development of Lionfish sighting forms (available on the sanctuary website), recreational divers are also able to provide observations and pictures of Lionfish sightings. FGBNMS is also working with the recreational dive charter M/V FLING, as dive masters have been permitted to remove Lionfish in the sanctuary. Divers on board the M/V FLING use weighted float chains to mark a Lionfish when diving at the sanctuary, and then permitted dive masters remove the Lionfish in the marked locations. As the invasion spreads, community involvement utilizing Lionfish derbies and targeted local removals at FGBNMS will be important control strategies. More about Lionfish: <http://flowergarden.noaa.gov/education/invasivelionfish.html>

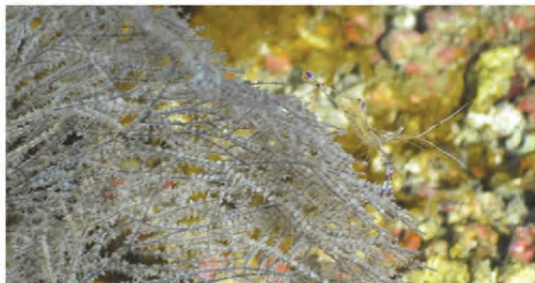


It is currently unknown what the impacts invasive Pacific lionfish will have on mesophotic communities. ROV surveys conducted by the FGBNMS and partners have documented the invasion at these depth ranges in the NW Gulf of Mexico. Image credit: FGBNMS/UNCW-UVP



Tracking the numbers of Lionfish sightings from before the invasion to present.

ANTIPATHARIAN DIVERSITY AND HABITAT SUITABILITY MAPPING IN THE MESOPHOTIC ZONE OF THE NORTHWESTERN GULF OF MEXICO



A black coral fan with a commensal *Pereclimenes* shrimp in mesophotic depth ranges. Image collected with Mohawk ROV.

Research Assistant Marissa Nuttall completed graduate work at TAMU-Galveston, studying the black corals of the Northwestern Gulf of Mexico. This work was Funded by NOAA's Deep Sea Coral Research and Technology Program (DSCRTP) and FGBNMS, and provided models for predicting mesophotic corals in the region, based on in situ antipatharian observations.

Project Abstract: Little is known about the distribution of black corals in the Northwestern Gulf of Mexico. Of thirty-nine species of black coral documented in the Western Atlantic, thirty have been previously documented by various studies in the Gulf of Mexico. The validation of *in situ* identifications of sixteen black coral species was evaluated, and recommendations for species identifications and species groupings were made. Black coral associated fauna were documented, supporting known, and documenting potentially new, species associations.

Habitat suitability models for the distribution of black coral species at selected banks in the Northwestern Gulf of Mexico were generated. Presence-only models made using the MaxEnt modeling program were compared to presence-absence models made using Boosted Regression Tree modeling techniques. Presence-absence models were documented to have greater predictive accuracy than the presence-only models, which showed evidence of model overfitting. The model was projected to five similar salt-dome features in the region, highlighting extensive habitat for multiple black coral species in these unexplored habitats. This study presents habitat suitability maps as a testable hypothesis for black coral distribution in the mesophotic zone of this region. More about Mesophotic Coral Ecosystems:

<http://flowergarden.noaa.gov/about/mesophotic.html>

CORAL IDENTIFICATION GUIDE DEVELOPED

Dr. Tom Bright led an effort to develop a picture guide to the common stony corals found in FGBNMS. This guide has turned out to be one of the most frequently downloaded files from our website. Tom is referred to as “the father of the Flower Garden Banks” (<http://flowergarden.noaa.gov/about/nwgulfbanksnames.html#bright>). He was instrumental in raising awareness and pushing forward legislation for the designation of the sanctuary. He was also one of the key TAMU researchers studying the reefs and banks of the NWGOM, including the Flower Garden Banks, throughout the 1970’s and 1980’s before becoming the Director of Texas Sea Grant. This guide was used during the inaugural FGBNMS Specialty Class developed for TAMUG. Download here: http://flowergarden.noaa.gov/document_library/scidocs/coralguidebright.pdf



CRUISES and EXPEDITIONS

Each year the Flower Garden Banks Research team participates in a variety of cruises to conduct sanctuary monitoring, research, and management activities. This is a summary of each of the cruises.

1&2. CRCP TECHNICAL DIVING CRUISE I and II – October 22-26 and October 30 – November 2, 2012. 10 Days at Sea (DAS) funded by FGBNMS/CRCP

The FGBNMS research team, ONMS divers, and partners from National Centers for Coastal Ocean Science, NOAA Fisheries, and TAMUG completed two weeks of technical diving at East and West Flower Garden Banks. Two days and one dive evolution were lost due to weather. Thirty-one of 40 targeted sites were completed - 19 at EFGB and 12 from WFGB. Unfortunately, this year Lionfish were found on 74% of the sites. Many Lionfish were smaller in size (<15 cm) with three fish in the 25-30 cm size class. Last year no Lionfish were seen during the technical dives. Acoustic fish surveys were completed on the EFGB cap, WFGB cap, and two ROV polygons in deepwater habitat. A crepuscular survey was conducted at HIA389A, the gas platform within the sanctuary boundaries at EFGB. Other highlights include tiger and spinner sharks, spawning sponges, a 10' manta ray, and large groupers.

3. WATER QUALITY CRUISE – November 8-9, 2012. 2 DAS funded by FGBNMS/BOEM/NMSF/CIMPSHIP FUND



Sea nettle photographed in sanctuary waters.
Image credit: FGBNMS/G.P. Schmahl

The FGBNMS research team, R/V MANTA crew, and TAMUG volunteer divers conducted a cruise to collect water samples at all three banks and download water quality instruments. A representative from Food and Drug Administration (FDA) also joined the cruise. Fish and algae were collected as part of a collaborative ciguatera study with FDA and University of Texas (UT). Samples were provided for mercury analysis in collaboration with GotMercury.Org.

Otoliths were removed from the fish for aging. Several Lionfish were collected – primarily at Stetson Bank. Two large coils of steel were removed from EFGB. Conditions ranged from 2'-5' seas with little current, up to 100' visibility, and water temperature was 78/79F. Notable sightings were several Loggerhead Sea Turtles on the surface and underwater, and multiple Tiger and Sandbar Sharks.

4. WATER QUALITY CRUISE – March 7, 2013. 1 DAS funded by FGBNMS/BOEM/NMSF/CIMPSHIP FUND

The FGBNMS research team, NOAA Corps Officers, and volunteer divers from TAMUG completed a one day trip to East and West Flower Garden Banks and Stetson Bank, to collect water samples and conduct maintenance on water quality instruments. Water temperature was 68F at EFGB, 67F at WFGB, and 67F at Stetson. Visibility was moderate, ranging from 30'-50'. Divers observed a Spotted Eagle Ray, a Greater Hammerhead Shark, a Scalloped Hammerhead Shark, Sandbar Sharks, and multiple large Greater Amberjacks. Lionfish were observed at Stetson Bank, where 5 small individuals were collected and removed from the reef.

5. POTENTIALLY SENSITIVE BIOLOGICAL FEATURES IV – April 22-2, 2013. 5 DAS funded by BOEM/FGBNMS. Alderdice and Rezak Banks.

The FGBNMS research team, with partners from BOEM, LUMCON and UNCW-UVP, and volunteers from TAMUG, completed four days of ROV operations at Alderdice and Rezak Banks in the Northwestern Gulf of Mexico. Despite rough weather, the team was able to complete all intended surveys at Alderdice Bank and half of the surveys at Rezak Bank. At both banks, researchers observed mesophotic fish and coral populations, including the invasive Lionfish.

6. POTENTIALLY SENSITIVE BIOLOGICAL FEATURES V – April 29-May 3, 2013. 5 DAS funded by BOEM/FGBNMS. Bouma and Sonnier Banks.

The FGBNMS research team, and partners from LUMCON, BOEM, and UNCW-UVP, with volunteers from various groups, completed another week of ROV exploration in the NW GoM. Researchers visited Rezak Bank, Bouma Bank, and Sonnier Bank, to conduct surveys on habitat that falls outside of the currently designated BOEM No Activity Zones (NAZ). A total of 120 surveys were conducted and participants saw multiple sharks, including a juvenile Tiger Shark, Lionfish, and entangled shrimp nets.

7. WATER QUALITY AND MOORING BUOY CRUISE – April 14-16, 2013. 3 DAS funded by FGBNMS/BOEM/NMSF-CIMPSHIP FUND.

The FGBNMS research team, along with volunteer divers from TAMUG, completed a two-day mission to maintain water quality instruments at each bank within the sanctuary, collect water samples, and install new mooring buoys.

One water quality instrument is located at



A spectacular colony of spiny flower coral (*Mussa angulosa*). Image credit: FGBNMS/G.P. Schmahl

the reef cap, measuring temperature and salinity, while another is located at the deep long-term monitoring stations, measuring temperature at ~130'. These instruments are maintained and downloaded on a quarterly basis. Water samples were also collected, and will be tested for common water quality parameters, including ammonia, nitrogen, phosphorous, nitrate, nitrite, and chlorophyll-a concentration. New moorings were installed at all the banks, resulting in a total of 5 buoys at East Flower Garden Bank, 3 at West Flower Garden Bank, and 3 at Stetson Bank

In addition, new long-term monitoring station installations were evaluated and coral collections conducted as part of a permitted research activity for Texas A&M University. Lionfish were observed at all of the banks and collected when possible. One collected Lionfish measured 16-inches in length, the largest Lionfish caught and reported in the sanctuary to date.

8. POTENTIALLY SENSITIVE BIOLOGICAL FEATURES VI – June 3-7, 2013. 5 DAS funded by BOEM/FGBNMS. Elvers and McGrail Banks.

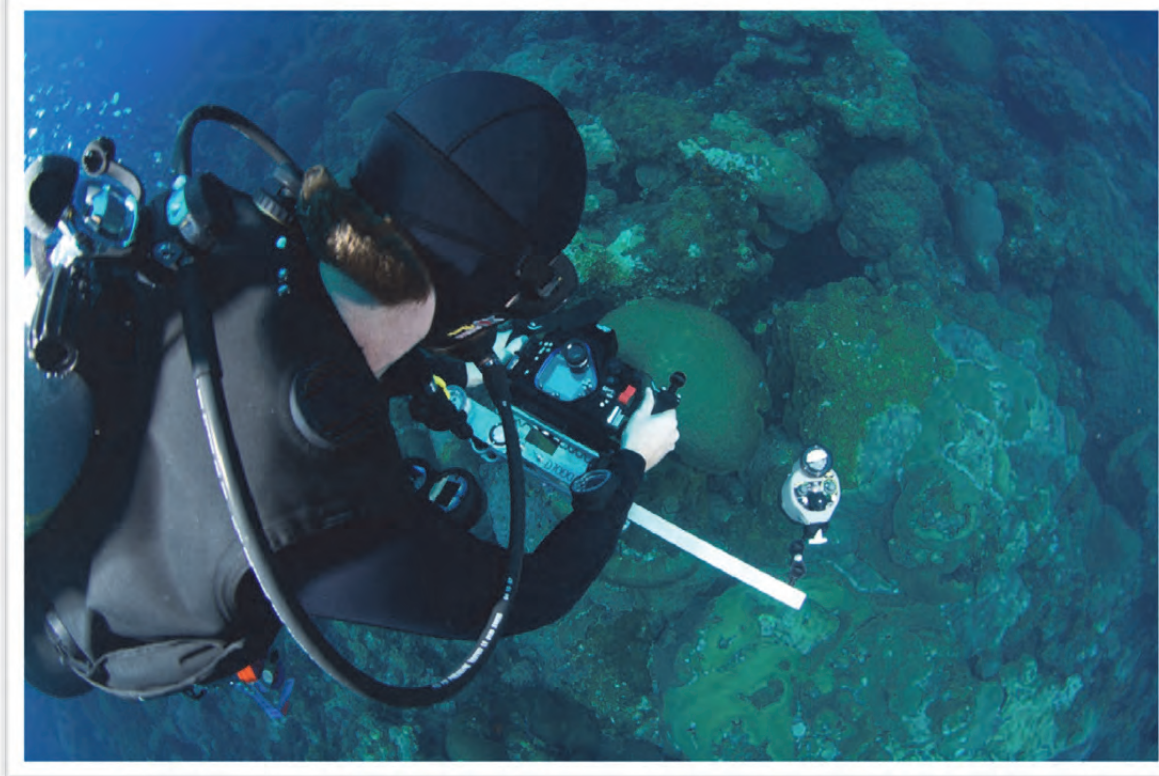
The FGBNMS research team joined with partners from the BOEM, NURC/UNCW, LUMCON, and student volunteers from Texas A&M University at Galveston this week to explore habitat in the Northwestern Gulf of Mexico. The team conducted approximately 100 transects at 20 drop sites at Elvers and McGrail Banks. Despite being chased in early by approaching foul weather, the team was able to complete the tasks planned for the cruise.

9. POTENTIALLY SENSITIVE BIOLOGICAL FEATURES VII – June 10-14, 2013. 5 DAS funded by BOEM/FGBNMS. Sidner and Parker Banks.

The FGBNMS research team, with partners from LUMCON, UNCW, and BOEM, along with volunteers from Texas A&M University at Galveston, completed the last of seven missions to characterize banks in the Northwestern Gulf of Mexico. Remotely Operated Vehicle (ROV) surveys were conducted at Sidner and Parker Banks.

10. GENERAL RESEARCH CRUISE – July 1-2, 2013. 2 DAS funded by FGBNMS.

A variety of tasks were conducted by the FGBNMS research team and TAMUG reciprocity divers. Two additional deep photostations were installed at East Flower Garden Bank to monitor *Madracis auretenra* coral patches, and all of the deep EFGB photostations were remapped. Algae samples were collected for a ciguatera collaboration with NCCOS, and coral was collected for ongoing coral characterization and identification efforts. A mooring buoy was installed at EFGB#5. 47 invasive Lionfish were speared and dissected for stomach content analysis, and prepared for sharing with partners. Still photography and HD video images were collected. TAMUG reciprocity divers practiced fish surveys and honed fish/coral species identification skills.



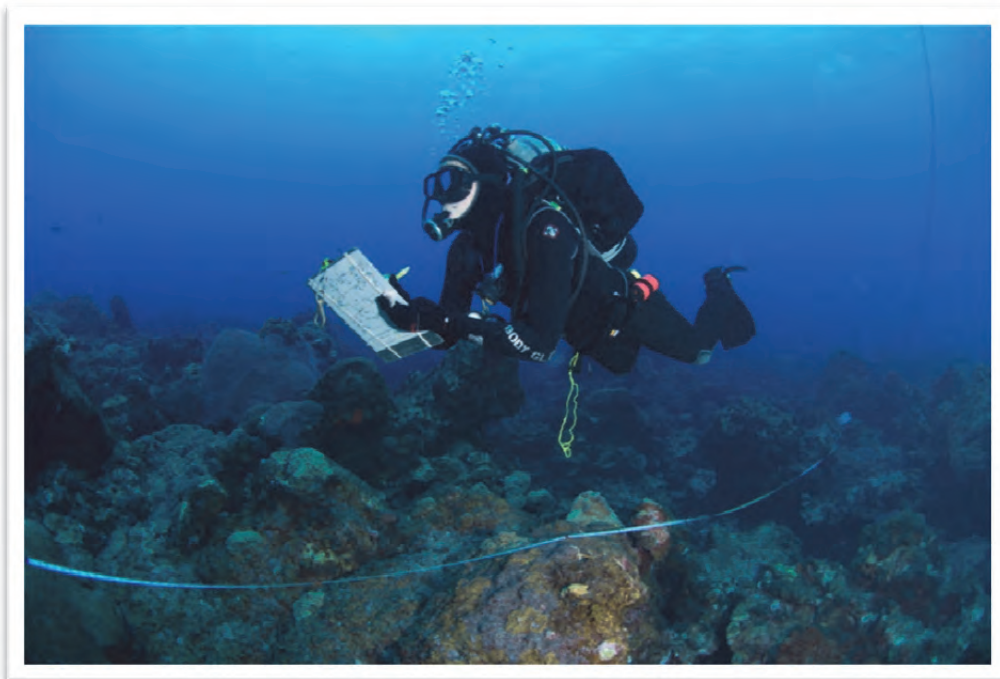
Ryan Eckert, a member of the FGBNMS research team, takes a photograph at a repetitive photostation at East Flower Garden Bank using a t-frame camera setup. Image credit: FGBNMS/G.P. Schmahl

11. LONG-TERM MONITORING – WFGB – August 12-16, 2013. 5 DAS funded by BOEM/FGBNMS, support provided by NMSF/NOKA FUND

The FGBNMS research team, along with divers from TAMUG and Gray's Reef National Marine Sanctuary (GRNMS), and partners from BOEM and BSEE, completed the 2013 annual long-term monitoring of West Flower Garden Bank. A total of 40 repetitive photostations were found and photographed, 12 deep repetitive photostations were found and photographed, 49 lateral growth stations were found and photographed, 16 ten-meter random photo transects were collected, 8 coral recruit and colony size surveys were completed, 40 fish surveys were conducted following the Bohnsack-Bannerot method and NCCOS transect method, 6 one-hundred-meter lobster and spiny sea urchin (*Diadema*) surveys were conducted at night, and 400 meters of perimeter lines were recorded using an HD video camera. In addition, 2 pins were refurbished. Additional activities included the observation of 76 invasive Lionfish and the removal of 62 Lionfish.

12. LONG-TERM MONITORING – EFGB – August 19-23, 2013. 5 DAS funded by BOEM/FGBNMS, support provided by NMSF/NOKA account.

The FGBNMS research team, along with divers from TAMUG, and partners from BOEM and BSEE, completed the 2013 annual long-term monitoring of East Flower Garden Bank. A total of 46 repetitive photostations were found and photographed, 11 deep repetitive photostations were found and photographed, 39 lateral growth stations were found and photographed, 16 ten-meter random photo transects were collected, 8 coral recruit and colony size surveys were completed, 24 fish surveys were conducted following the Bohnsack-Bannerot method and NCCOS transect method, 2 one-hundred-meter lobster and spiny sea urchin (*Diadema*) surveys were conducted at night, and 400 meters of perimeter lines were recorded using an HD video camera. In addition 4 pins were refurbished and 5 new lateral test stations installed. Additional activities included the observation of 42 invasive Lionfish, and the removal of 22 Lionfish.



Marissa Nuttall, a member of the FGBNMS research team, conducts a Bohnsack-Bannerot fish survey as part of the long-term monitoring project. Image credit: FGBNMS/G.P. Schmahl



Seven to ten days after the August full moon, around 8:30 pm, the reefs of the Flower Garden Banks erupt into an underwater blizzard comprised of millions of gamete bundles being released by spawning corals. Here, a star coral is releasing bundles containing both egg and sperm. The bundles float to the surface, breaking apart as they head upwards, mixing with different colonies to fertilize and develop as the next generation of corals. Image credit: FGBNMS/G.P. Schmahl

13. CORAL SPAWNING CRUISE – August 26-30, 2013. 5 DAS funded by NMSF/NOKA/FGBNMS

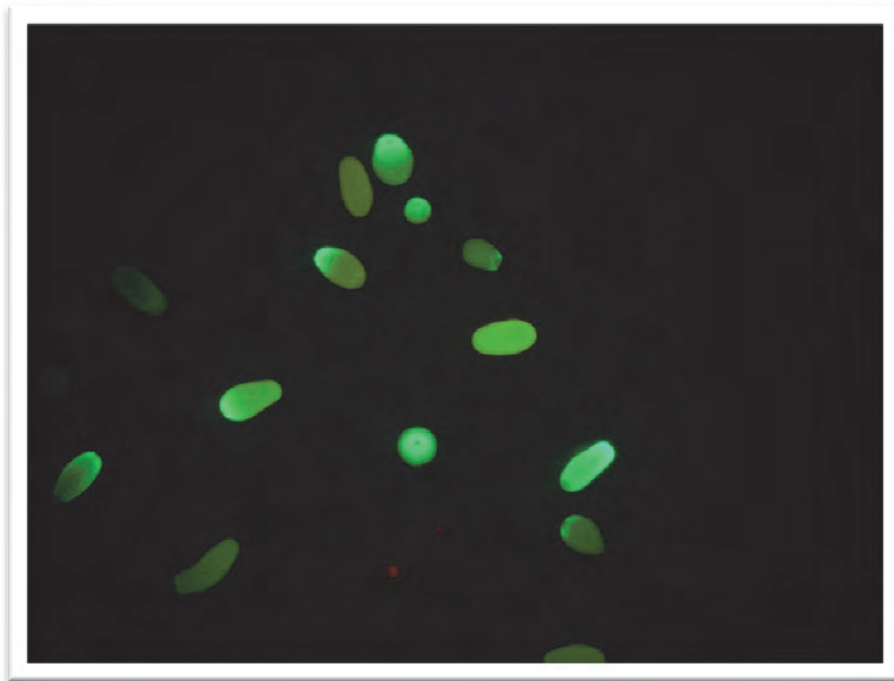
The FGBNMS research team, along with researchers from UT, OSU, and TAMUG completed a successful cruise to document the annual coral spawning event at the sanctuary. Researchers from UT and OSU collected coral fragments from four different coral species, including the invasive *Tubastraea* sp., for genetic analysis. In addition, they collected coral spawn from a variety of species for laboratory experiments. TAMUG researcher and graduate student Tommy Heathman, with assistance from FGBNMS divers, completed two deployments of a benthic lander to measure sedimentary respiration and photosynthesis. Heathman also collected sediment samples to identify fauna contributing to the sedimentary respiration rates. FGBNMS research staff conducted range testing for the acoustic receiver array, evaluating how close an animal must be to a receiver in order to be detected. On Tuesday night (Aug 27, 2013), researchers observed multiple colonies of *Orbicella* (formerly *Montastraea*) *franksi*, and *Montastraea cavernosa*. On Friday night (Aug 28, 2013), they observed multiple colonies of *Pseudodiploria strigosa*, *Orbicella* (formerly *Montastraea*) *franksi*, *Orbicella* (formerly

Montastraea faveolata, and *Orbicella* (formerly *Montastraea*) *annularis*. Throughout this cruise, researchers were treated to multiple encounters with Manta Rays, Mobulid Rays, and even a few sharks. Images of the Manta Rays' unique spot patterns will be entered into the FGBNMS Manta Catalog.

Specific research questions conducted during coral spawning:

Dr. Mikhail Matz, UT Austin: Many coral colonies at the Flower Garden Banks attain enormous sizes and therefore must be hundreds, if not thousands, of years old. How does such an old organism guard itself against random mutations, which should be slowly accumulating with time? With the project initiated this year at FGB, we hope to understand the process of mutation accumulation within old coral colonies and to identify molecular mechanisms mitigating their detrimental effects.

Marie Strader, PhD student, UT Austin: Corals can move around in search of better conditions and make life-long decisions – to stay or move on – when they are tiny larvae dispersing with the ocean currents. This process is the key to healthy replenishment of coral populations. My project aims to elucidate the molecular mechanisms of larval decision-making and to understand how they might be affected by climate change. My current focus is on the synergistic effects of larval fluorescence (see picture) and light conditions on the reef.



Fluorescence of 5-day old larval brain coral – *Diploria strigosa*. Image credit: UT/M. Strader

Dr. Sarah W. Davies, UT Austin: The Flower Garden Banks has some of the highest coral cover in the Caribbean and its yearly gamete output during mass-spawning events is enormous; however, FGB is about 600 km away from the nearest other coral reef. Are coral larvae from FGB able to reach and populate other reefs throughout the Caribbean, or FGB does not really participate in maintenance of genetic diversity and larval supply in the region due to its remoteness? My research addresses this question through a combination of genetics, larval physiology studies, and biophysical modeling.

Dr. Eli Meyer, Oregon State University: Reef-building corals are highly sensitive to thermal stress. Small increases in temperature cause bleaching, reduce fecundity and growth, and can lead to mortality and degradation of reefs. This project will look at the genetic variability of thermal tolerance in the FGBNMS corals.



Tenting of a star coral, *Orbicella franksi*, to collect gametes during the mass spawning event. Image credit: FGBNMS/G.P. Schmahl



An unusual coloration of a tiger grouper (*Mycteroperca tigris*). Image credit: FGBNMS/Ryan Eckert

conducted to document the fish populations, and both line point intercept and coral demography (1x10m) surveys were conducted to document the high coral cover. Approximately 170 dives were conducted to complete the tasks on both banks.

This project is funded by NOAA's Coral Reef Conservation Program and supported by NCCOS and FGBNMS. This is an important study that complements the annual long-term monitoring which is co-funded by FGBNMS and BOEM and that takes place in 100mx100m study sites on each coral cap.

11. NATIONAL CORAL REEF MONITORING PROGRAM – September 2-6, 2013. 5 DAS funded by CRCP/FGBNMS.

The FGBNMS Research Team, NCCOS, NOAA/SEFSC, and TAMUG divers completed the first field component of the newly developed National Coral Reef Monitoring Program at East and West Flower Garden Banks on board the R/V MANTA. During the cruise, 70 randomly selected dive sites were surveyed for both fish and benthic composition at depths to 100 ft. Twenty-five-meter (25m) belt transects were



A common octopus (*Octopus filiosus*) has plans to make a meal out of this Atlantic deer cowrie (*Macrocypaea cervus*). Image credit: Matt Stout

ADDITIONAL R/V MANTA CRUISES

The R/V MANTA was chartered by several different user groups during the 2013 research season.

1. University of Texas Marine Science Institute: May 19-24, 2013

The purpose of this cruise was to train students in marine geology and geophysics field techniques, including multi-channel seismic, CHIRP acoustic reflection, and multi-beam bathymetric surveys. Data was collected offshore of Galveston, TX, in Bolivar Roads and Galveston Bay. Students later analyzed data to investigate issues regarding stratigraphy and sediment transport at these locations.

2. DiMarco (TAMU) – Methods Controlling Hypoxia Survey (MCH7): June 18-25, 2013

The goal of this project was to estimate the areal extent and vertical distribution of dissolved oxygen concentration and hydrographic properties in the northwest region of the Gulf of Mexico.

3. DiMarco (TAMU) – Glider Testing: June 28, 2013

The purpose of this trip was to perform a test deployment of two newly-acquired Teledyne Webb Slocum G2 gliders with faculty and students from Texas A&M University. Operations included deploying and recovering the gliders, which were piloted from a command center on shore, using the R/V MANTA RHIB. Both gliders ran successfully, and future glider operations on board the R/V MANTA are anticipated.

4. Rooker (TAMUG) – MOCNESS training/testing: July 16-17, 2013

The purpose of this trip was to train students and professors of the TAMUG Fisheries Ecology Lab how to operate the Multiple Opening/Closing Net Environmental Sensing System (MOCNESS). The plan was to exercise each of the nine nets on the MOCNESS in open water where the depth was approximately 100'. Unfortunately, there were some technical difficulties with the communications equipment and Erich F. Horgan, a technician from Biological Environmental Sampling Systems, Inc. (B.E.S.S.), was unable to demonstrate the operation of the MOCNESS underway. However, valuable experience was gained assembling and setting the system up in preparation for future missions in the Gulf of Mexico.

5. DiMarco (TAMU) – Methods Controlling Hypoxia Survey (MCH8): August 3-10, 2013

The goal of this project, as in the MCH7 Survey, was to estimate the areal extent and vertical distribution of dissolved oxygen concentration and hydrographic properties in the northwest region of the Gulf of Mexico. Oceanographic observations were taken at 70 stations across the Texas-Louisiana continental shelf from East Matagorda Bay, TX, to the Mississippi River delta at Southwest Pass, LA. An undulating towfish vehicle (SeaSciences, Inc.) Acrobat was pulled behind the ship along 13 cross-shelf lines and provided vertical sections (spatially distributed profiles) of temperature, salinity, oxygen, chlorophyll and CDOM fluorescence. 11060 km² were below the 1.4 ml/L dissolved oxygen threshold for hypoxia. Hypoxia was most severe in the Louisiana Bight region of the shelf near the Mississippi River delta and south of the Atchafalaya Bay of central Louisiana. Hypoxia was also seen between Calcasieu and Cameron, LA. Hypoxia was observed along the Texas coast south of High Island, Galveston, and Matagorda, Texas. The MS08 cruise was the fourth August cruise designed to estimate the size of the Texas-Louisiana hypoxic area in mid to late summer. The hypoxic area was about the same as observed by the science crew during the June 2013 cruise.

6. Environmental Protection Agency (EPA) – September 23-30, 2013

The purpose of the survey was to collect data to assess performance and site conditions relative to disposal operations in the Sabine Neches Ocean Dredged Material Disposal Sites (ODMDS). Analysis of sediment samples collected from the ODMDS were conducted to allow evaluation of potential physical, chemical, and biological impacts from dredged material disposal, which is expected to be limited to temporary localized physical impacts (i.e. burial). Sediment samples were collected using a double Van Veen grab, and a Sediment Profile Imaging (SPI) camera was used to capture images to delineate the horizontal extent of the dredged material footprint. SPI images were acquired at all 130 planned sites, and 55 sediment samples (100% of planned samples) were collected during the trip.

Additional cruises

July 29-31, 2013 M/ V FLING. Agency/Industry Cruise. Emma Hickerson and G.P. Schmahl participated in the 2013 Agency/Industry Cruise

ADDITIONAL SCIENCE ACTIVITIES

1. Permitting
2. Mooring buoy installation and maintenance
3. Scheduling of R/V MANTA
4. Coordination of scuba operations
5. Coordination of shipboard research equipment and activities
6. Submission of NOAA fleet ship-time requests and needs
7. Regional GIS support
8. Science presence at SAC meetings
9. Participation in NOAA Coral Collaboration calls
10. Participation in NOAA Deep Sea Coral calls
11. Participation in development of NOAA Gulf of Mexico Digital Atlas
12. Support of Artificial Reef Working Group activities (Embesi)
13. Participation in Biological Team for Monterey Ship Wreck



A three-spot damselfish (*Stegastes planifrons*) hovers in between fingers of a mound of mixed corals.
Image credit: FGBNMS/G.P. Schmahl



2013 Ocean Discovery Day interactive mural project - Kelp Forests of the West Coast National Marine Sanctuaries. The original artwork (below) is gridded out for visitors to pick a square to recreate. Original artwork by Marine Educator/Artist, Jacqui Stanley

SCIENTIFIC INTERPRETATION/OUTREACH

1. FGBNMS Coral Identification Guide finalized – Dr. Tom Bright, Hickerson
2. Ocean Discovery Day – Kelp Forest Mural
3. NABS – Johnston, Eckert, Embesi
4. Lionfish school visitations – Nuttall, Embesi
5. REEF/FGBNMS Lionfish workshops
6. Contributions to digital slide catalog/library
7. Contributions to video library, including annotations
8. Development of PowerPoint presentations for various events
9. Provided significant content for sanctuary website
10. Web-based research reports and blogs
11. Response to “Into the Sea” mail - Hickerson



CONFERENCES, MEETINGS, PRESENTATIONS, TRAINING, ETC.

1. November 14, 2012 Bay Area Divers. Lionfish Presentation. Johnston
2. November 14, 2012 Lunar Fins. Whale sharks, manta rays, seaturtles, Oh My! Houston, TX. Nuttall
3. February 6, 2013 Sanctuary Science. Seaside Chats. Galveston, TX. Hickerson
4. February 2013 Underwater Research Methods. TAMUG. Galveston, TX. Nuttall
5. February 2013 FGBNMS. Conroe Elementary School. Conroe, TX. Nuttall
6. May 30, 2013 FGBNMS presentation. Patton Elementary School, Austin, TX. Hickerson
7. March 18, 20, 2013 TAMUG Scientific Diving Program. Hickerson
8. April 2013. 6 classes. TAMUG FGBNMS Specialty Class
9. June 17-21, 2013. Primer Training. Houston, TX. Nuttall.



Green morays (*Gymnothorax funebris*) are rarely seen in the sanctuary – this large individual was photographed at East Flower Garden Bank. Image credit: FGBNMS/G.P. Schmahl

ABSTRACTS AND PUBLICATIONS

- Davies SW, Matz MV, Vize PD (2013) Ecological Complexity of Coral Recruitment Processes: Effects of Invertebrate Herbivores on Coral Recruitment and Growth Depends Upon Substratum Properties and Coral Species. PLoS ONE 8(9): e72830. doi:10.1371/journal.pone.0072830
<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0072830>
- DeBose J, Nuttall M, Hickerson E and Schmahl G (2013) A high latitude coral community at the tipping point: Stetson Bank, Northwestern Gulf of Mexico. Coral Reefs.
- Hickerson E, Schmahl G, Johnston M, Nuttall M, Embesi J, Eckert R, (2013) Flower Garden Banks – A Refuge in the Gulf of Mexico. Proc 11th Intl Coral Reef Symposium
- Schmahl G, Hickerson E, and Nuttall M (2013) Science-based design of coral protected areas in the Gulf of Mexico. Proc 11th Intl Coral Reef Symposium
- Teague, W.J., Wijesekera, H.W., Jarosz, E., Fribance, D.B., Lugo-Fernandez, A., Hallock, Z.R. (2013) Current and hydrographic conditions at the East Flower Garden Bank in 2011. Continental Shelf Research 63 (2013) 43-58.
- Tester, P.A., Vandersea, M.W., Buckel, C.A.; Kibler, S.R., Holland, W.C., Davenport, E.D., Clark, R.D., Edwards, K.F., Taylor, J.C., Vander Pluym, J.L., Hickerson, E.L., Litaker, R.W. (In Press) Gambierdiscus (Dinophyceae) Species Diversity in the Flower Garden Banks National Marine Sanctuary, Northern Gulf of Mexico, USA. Harmful Algae.

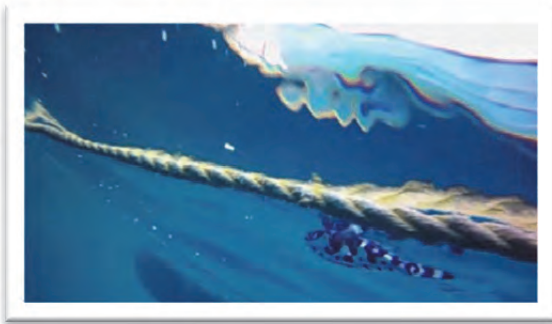


Red-eyed sponge crab (*Dromia erythropu*) out on the reef during a night dive.
Image credit: FGBNMS/G.P. Schmahl

FUNDING

- \$121,000 BOEM – PSBF (includes ROV time)
- \$181,213 BOEM – FGBNMS LTM
- \$20K requested from Texas State Aquarium, Corpus Christi, for Lionfish workshops and removals

NEW SANCTUARY BIOLOGICAL RECORDS



→ **Man-of-War fish** *Nomeius gronovii*
Photographed by James N. Tyler at HIA389A on May 5, 2013



Callinectes exasperates – WFGB
26m, 25 May 1972, collected by Dr. Tom Bright, cat. No. 2-2526. Specimen was being eaten by a 3-spot damselfish at the time of collection. Identified by Dr. Mary Wicksten from old TAMU collections. (No image)

→ *Martensia pavonia* – sampled by FGBNMS in August 2010. Identified by Dr. Suzanne Fredericq in 2013. Is fluorescent orange when decomposing.

RESEARCH AND SCIENCE PARTNERSHIPS

- Bureau of Ocean Energy Management (BOEM)
- Cooperative Institute of Ocean Exploration, Research and Technology (CIOERT)
- Food and Drug Administration (FDA)
- GotMercury.org
- Harbor Branch Oceanographic Institute (HBOI)
- National Centers for Coastal Ocean Science (NCCOS)
- National Coastal Data Development Center (NCDDC)
- Oregon State University (OSU)
- Texas A&M University (TAMU)
- Texas A&M University – Galveston (TAMUG)
- Texas A&M University – Corpus Christi (TAMU-CC)
- University of North Carolina – Wilmington (UNCW)
- University of Texas

RESEARCH STAFFING

1. Ryan Eckert, Research Assistant
2. John Embesi, Research Assistant
3. Emma Hickerson, Research Coordinator
4. Michelle Johnston, FGBLTM Project Manager
5. Alyson Kuba, Hollings Scholar and Research Intern – PSBF project
6. Kaitlin McGraw – Research Intern – PSBF project
7. Marissa Nuttall, Research Assistant
8. G.P. Schmahl, Sanctuary Superintendent

R/V MANTA core crew –services provided by BlueStar Marine, Inc., owned and operated by Captain Darrell Walker:

1. Captain Michael Shetler
2. First Mate Mike Petry
3. Deck Julia O’Hern
4. Galley Tina Thompson/Jeremy Fox/ A.J. Ruffer

FGBNMS NOAA Divers:

1. Kelly Drinnen
2. Ryan Eckert
3. John Embesi
4. Emma Hickerson (Unit Diving Supervisor)
5. Michelle Johnston
6. Marissa Nuttall
7. Jamie Park
8. G.P. Schmahl
9. Michael Shetler
10. Darrell Walker

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Flower Garden Banks NMS Research Team (L-R) John Embesi, Michelle Johnston, Marissa Nuttall, Ryan Eckert, Emma Hickerson



AMERICA'S UNDERWATER TREASURES