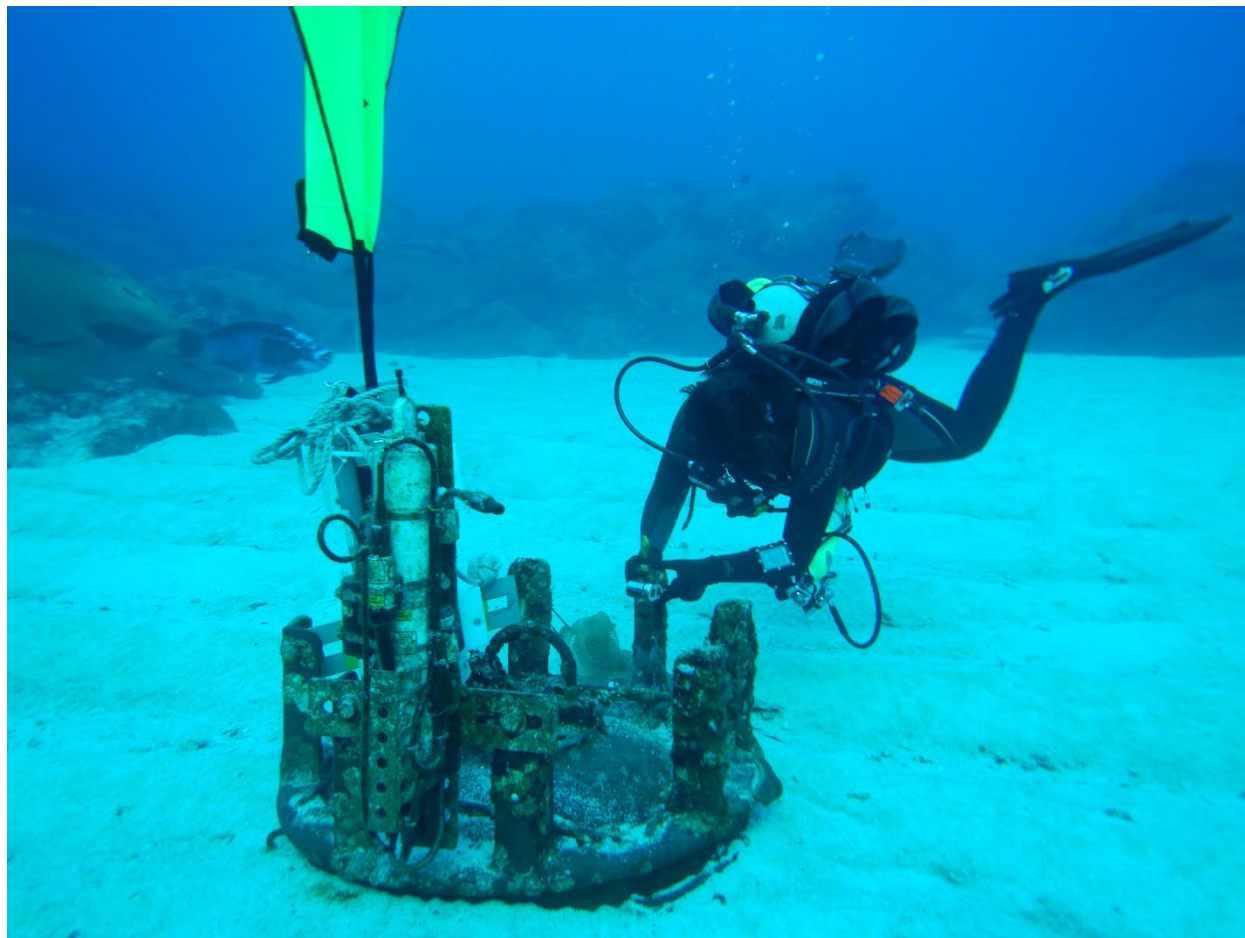




Flower Garden Banks National Marine Sanctuary 2021 Research, Monitoring, and Resource Protection Report



May 2022

U.S. Department of Commerce
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**NATIONAL
MARINE
SANCTUARIES**

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Cover photo: A diver inspects water quality instrumentation on the reef at West Flower Garden Bank.
Photo: Adrienne Correa/Rice University



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Report Availability

Electronic copies of this report may be downloaded from Flower Garden Banks National Marine Sanctuary website at <https://flowergarden.noaa.gov>

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Overview

The purpose of this document is to report the activities of the Flower Garden Banks Research, Monitoring, and Resource Protection team during fiscal year (FY) 2021.

The team was involved in three cruises between June 1, 2021 and September 30, 2021. Limited offshore cruises have taken place since March 17, 2020, due to the COVID-19 pandemic restrictions and precautions (i.e., mission approval by regional managers, reduced crew and divers on the vessel, testing requirements, etc.). The team began teleworking in mid-March, 2020 and continued to do so through FY21. Research efforts were primarily focused on supporting FGBNMS boundary expansion, data analysis, and publication and report development. The R/V *Manta* was utilized by the team for a period of six days to conduct the operations. A pool of 10 sanctuary personnel, scientists, reciprocity divers, and NOAA dive center personnel conducted 65 scuba dives. Ten percent of the dives were conducted by volunteer divers. Activities were focused on mooring buoy installations, water quality instrument changeouts, and collection of long-term monitoring repetitive photographs. Five sanctuary permits were processed and five additional permits were ongoing.

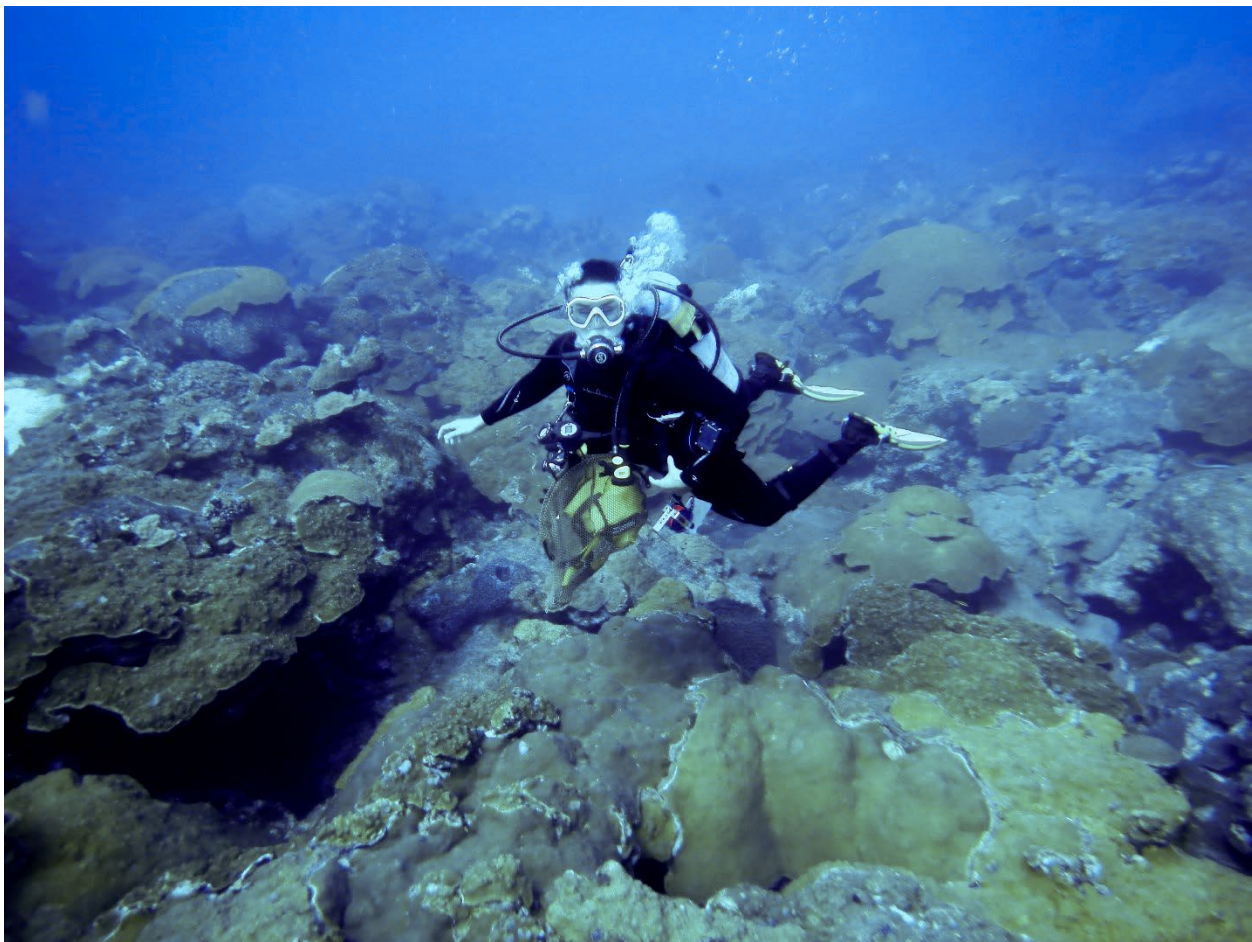


Figure 1. A scuba diver swims above massive boulder coral colonies at West Flower Garden Bank. Photo: Kelly O'Connell/CPC, Inc.

Research Staff Projects

Raven Blakeway

- Stetson Bank Long-Term Monitoring Program Project Manager
- Southeast Deep Coral Initiative Deep-Sea Coral Research and Technology Program Report Lead

Karol Breuer

- Mooring Buoy Lead

Emma Hickerson

- Research and Monitoring Coordinator
- Permit Coordinator
- Resource Protection Coordinator

Ryan Hannum (as of 9/21/21)

- Water Quality Project Manager
- Research program support

Michelle Johnston

- East and West Flower Garden Banks Long-Term Monitoring Project Manager
- HI-A-389-A Report Lead
- Invasive Species Lead
- Climate Lead
- Stony Coral Tissue Loss Disease Lead
- Cruise Coordinator
- Condition Report Lead

Jimmy MacMillan (through 2/26/21)

- Water Quality Project Manager
- Research program support

Marissa Nuttall

- CPC Team Lead
- Unit Diving Supervisor
- GIS Lead
- Deep Fish Habitat (DFH) Lead
- Deep Water Horizon Lead
- Acoustics Lead

Kelly O'Connell

- Water Quality Co-Lead
- Manta Ray Catalog Lead
- Research program support
- Marine Debris Report Lead

FY2021 Highlights

Stony Coral Tissue Loss Disease Response Plan Published

Stony coral tissue loss disease (SCTLD) has spread throughout the Florida Reef Tract since 2014 and into many Caribbean countries and territories. Though SCTLD recently (May 2021) emerged in the Dry Tortugas it has not yet affected the remote reefs of Flower Garden Banks National Marine Sanctuary (FGBNMS). However, the number of susceptible coral species present and high coral cover at FGBNMS (over 50%) suggest this location may be hit hard if the disease reaches the sanctuary. Building on knowledge gained in the Florida Keys and other locations, the FGBNMS established a comprehensive [SCTLD prevention and response plan](#) with prevention, education, preparedness, early warning, response, and intervention strategies, which could prevent disease spread to FGBNMS and allow for a rapid and effective response should the need arise. As part of the plan, FGBNMS staff worked with [MPACConnect](#) to create a sanctuary-specific coral disease identification poster to share with divers and dive boats frequenting the sanctuary. The plan is published as part of the ONMS Conservation Series.

Publication on the Value of Low Relief Habitat for Mesophotic Corals

The science team published a manuscript in [Frontiers in Marine Science](#) that utilized over 10 years of data collected by remotely operated vehicles in the deeper habitats in and near the sanctuary to examine the abundance and diversity of mesophotic coral forests on the continental shelf in the northwestern Gulf of Mexico. Authors found that the region harbors some of the densest mesophotic coral forests reported to date and highlights the persistence of dense and diverse communities on low relief rock substrates. This data supports the need for current oil and gas no activity zones and potentially sensitive biological feature designations, and recommends that these lease stipulations should be expanded to include assemblages on features of lower relief in order to protect vulnerable communities.

New Publication on Lionfish Culling Efficiency

A new manuscript highlighting sanctuary lionfish data entitled "Multiple drivers of invasive lionfish culling efficiency in marine protected areas" was published in [Conservation Science and Practice](#). Authors coordinated regional efforts by divers to cull invasive lionfish (*Pterois* spp.) on 33 U.S. Atlantic, Gulf of Mexico, and Caribbean protected coral reefs from 2013 to 2019 and estimated removal efficiency and efficacy as a function of environmental and habitat conditions, invasion status, and personnel expertise. Results show that highly experienced individuals culling during crepuscular periods (<2 hours from sunrise/sunset) are three times more efficient (in terms of minutes) than novice divers during midday, suggesting: (a) retention of experienced individuals is key for efficient programs, and (b) planning culls with personnel and time of day in mind increases the number of sites covered with the same effort. Lionfish behavior and habitat characteristics had little effect on removal efficiency and efficacy, but divers had higher capture success at reefs with higher lionfish densities. Results suggest reefs with persistently <20 fish per hectare as low priority, given that impacts to native fauna are unlikely and culling effectiveness declines to <50% below this level.

Cruises and Expeditions

The following cruises were conducted on board R/V *Manta* (Figure 2), unless indicated otherwise.

June 24-26, 2021 - Mooring buoy maintenance, water quality instrument changeouts, general inspection

August 25-26, 2021 – East Flower Garden Bank Monitoring of repetitive photostations

September 25, 2021 – Stetson Bank Monitoring of repetitive photostations and water quality instrument changeout



Figure 2. FGBNMS Research Vessel MANTA. Photo Credit: Voss Lab/FAU

Additional R/V Manta Cruises

The R/V *Manta* was chartered by Harbor Branch Oceanographic Institution-Florida Atlantic University from July 31-August 4, 2021 for technical diving operations looking at connectivity of corals and sponges in mesophotic depths. Principle Investigator – Dr. Joshua Voss.

Additional Research, Monitoring and Resource Protection Activities

Mapping Portal Updates

Sanctuary staff continued to work with NOAA's National Centers for Environmental Information (NCEI) to update the GIS-based mapping portal which serves the sanctuary's spatial data, mapping information, and long-term monitoring data online.

Computer Learning to Automate Coral Identification

Sanctuary staff continued to collaborate with Swift Engineering in an effort to develop machine learning capabilities to automate coral identification for East and West Flower Garden Banks long-term monitoring image analysis.

Boundary Expansion

Sanctuary expansion was finalized in January 2021. The boundary expansion effort was strongly supported by research staff, primarily Emma Hickerson, Marissa Nuttall, and Raven Blakeway, in document development, outreach material development, and GIS support.

Mooring Buoys

Karol Breuer took on the role of co-lead for the mooring buoy program with Emma Hickerson. They provided mooring buoys to Fling Charters during 2021 while sanctuary staff were unable to be offshore. Moorings were prepared for installation to support Fling Charters' commercial operations, and build up an inventory of mooring buoys and supplies for future installations.

National Coral Reef Status Report Card

Staff worked with NOAA's National Coral Reef Monitoring Program (NCRMP) to finalize the National Coral Reef Status Report Card section highlighting FGBNMS long-term monitoring and NCRMP data, available here: https://www.coris.noaa.gov/monitoring/status_report/

Coral Reef Conservation Program (CRCP) Funding Awarded

FGBNMS and NCRMP were awarded CRCP funds for a three-year data integration project to calibrate the two separate monitoring programs. Michelle Johnston and Erica Towle (NCRMP) are co-PIs on this project. The project has been rescoped into a two-year project to account for COVID-19 delays and will begin in 2022.

Archiving Monitoring Data

Sanctuary staff are working with NOAA's National Centers for Environmental Information (NCEI) to archive East Flower Garden Bank, West Flower Garden Bank, and Stetson Bank long-term monitoring data. Michelle Johnston, Marissa Nuttall, and Raven Blakeway have successfully archived several years of data, and will continue working to archive additional years. The data can be located using the NCEI Geoportal (<https://www.ncei.noaa.gov/metadata/geoportal/#searchPane>).

Ciguatera Monitoring Collaboration

Sanctuary staff initiated and developed a collaboration with NOAA National Centers for Coastal Ocean Science (NCCOS) and the Food and Drug Administration (FDA) to monitor ciguatera in samples collected by National Marine Fisheries Service Southeast Area Monitoring Assessment Program (SEAMAP) activities. NCCOS received samples from SEAMAP 2021 collections. Once analyzed, any anomalous results will be passed onto FDA for reanalysis, confirmation, and response, if needed, for public awareness.

Reef Fish Connectivity Study

NCCOS's Regional Ecosystem Research Program, focused on understanding species' habitat usage and connectivity, funded a [collaborative study](#) to investigate migration ecology and habitat requirements of reef fishes in the Gulf of Mexico (NA21NOS4780151). The study is led by Dr. Jay Rooker, of Texas A&M University, and represents a collaboration between five universities, the Southeast Fisheries Science Center, and FGBNMS, and will examine habitat use, site fidelity, competition, and connectivity both at the bank scale and across the sanctuary's expansion area for demersal and pelagic fishes.

PROTEUS Pilot

Sanctuary staff are participating in a pilot project to help understand vessel activity in the sanctuary. The pilot program is supported by the U.S. Naval Research Lab and allows users to monitor VMS and AIS vessel tracks and setup alerts. The tool will help managers better understand vessel use within the remote sanctuary and has potential enforcement uses.

Manta Ray Catalog

Sanctuary staff are working to convert the manta ray catalog to a more user-friendly web format and have uploaded the manta sighting database to [Manta Matcher](#). The website uses an algorithm to automatically distinguish individuals using photos of manta bellies, similar to facial recognition software. Any diver or snorkeler with a camera can identify an individual manta ray. By uploading manta identification photos and information about manta encounters, recreational divers can participate in citizen science and assist with global manta ray research and conservation. In FY21, only one new individual was cataloged bringing the total number of individuals to 102, with 25 individual resightings.

Lionfish

While lionfish cruises were canceled due to COVID-19, Michelle Johnston contributed to a manuscript on lionfish removal efficacy lead by Dr. Alexandria Davis from the University of Alberta. Michelle Johnston and Steve Gittings also presented to Good Pitch Texas on a lionfish documentary with staff from Lionfish University in October 2020.

Data Mining

Staff continued mining data from cruise annotations to develop species lists for the FGBNMS expansion areas, and a report detailing the marine debris encountered at all sanctuary sites.

FGBNMS Condition Report Vetting Meetings

Indicator vetting meetings were held with sanctuary staff and a select group of subject matter experts to identify and sort data indicators and data sets for the sanctuary condition report. This information will be used to draft the new FGBNMS Condition Report and will provide a summary of resources in FGBNMS, including information on the status and trends of water quality, habitat, living resources, and ecosystem services.

Publications

- Blakeway, R.D., A.Q. Fogg, and G.A. Jones. 2021. Oldest Indo-Pacific Lionfish (*Pterois volitans/P. miles*) Recorded From the Northwestern Gulf of Mexico. Gulf and Caribbean Research. 32(1): GCFI1-GCFI4. <https://doi.org/10.18785/gcr.3201.01>
- Blakeway, R.D., Ross, A.D., Jones, G.A. 2021. Insights from a Survey of Texas Gulf Coast Residents on the Social Factors Contributing to Willingness to Consume and Purchase Lionfish. *Sustainability*, 13, 9621. <https://doi.org/10.3390/su13179621>
- Clements KR, Karp P, Harris HE, Ali F, Candelmo A, Rodríguez SJ, Balcázar-Escalera C, Fogg AQ, Green SJ, Solomon JN. The Role of Citizen Science in the Research and Management of Invasive Lionfish across the Western Atlantic. *Diversity*. 2021; 13(12):673. <https://doi.org/10.3390/d13120673>
- Davis, A. C. D., Akins, L., Pollock, C., Lundgren, I., Johnston, M. A., Castillo, B. II, Reale-Munroe, K., McDonough, V., Moneysmith, S., & Green, S. J. (2021). Multiple drivers of invasive lionfish culling efficiency in marine protected areas. *Conservation Science and Practice*, e541. <https://doi.org/10.1111/csp2.541>
- Etnoyer, P., R. Bassett, C. Adams, T. Battista, R. Blakeway, S. Harter, J. Howell, J. Lunden, R. McGuinn, M. Nizinski, K. Overly, M. Poti, E. Salgado, A. Shuler, A. Skarke, H. Coleman, and T. Hourigan. 2021. Southeast Deep Coral Initiative (SEDCI) 2016-2019: Final Report to NOAA Deep Sea Coral Research and Technology Program. NOAA Tech. Memo. NMFS-OHC-9, 116 p.
- Johnston, M.A. 2021. Strategy for Stony Coral Tissue Loss Disease Prevention and Response at Flower Garden Banks National Marine Sanctuary. National Marine Sanctuaries Conservation Series ONMS-21-06. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Flower Garden Banks National Marine Sanctuary, Galveston, TX. 30 pp. <https://sanctuaries.noaa.gov/media/docs/202107-strategy-for-stony-coral-tissue-loss-disease-prevention-repsonse-at-fgbnms.pdf>
- Johnston, M.A., K. O'Connell, R.D. Blakeway, J. MacMillan, M.F. Nuttall, X. Hu, J.A. Embesi, E.L. Hickerson, and G.P. Schmahl. 2021. Long-Term Monitoring at East and West Flower Garden Banks: 2019 Annual Report. National Marine Sanctuaries Conservation Series ONMS-21-02. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Flower Garden Banks National Marine Sanctuary, Galveston, TX. 88 pp. <https://sanctuaries.noaa.gov/media/docs/2019-fgbnms-long-term-monitoring.pdf>

Kelley, E.R., R.S. Sleith, M.V. Matz, and R.M. Wright. 2021. Gene expression associated with disease resistance and long-term growth in a reef-building coral. Royal Society Open Science. 8:210113. <https://doi.org/10.1098/rsos.210113>

Manzello, D.P., Kolodziej, G., Kirkland, A. *et al.* Increasing coral calcification in *Orbicella faveolata* and *Pseudodiploria strigosa* at Flower Garden Banks, Gulf of Mexico. *Coral Reefs* 40, 1097–1111 (2021). <https://doi.org/10.1007/s00338-021-02108-8>

Nuttall MF, Somerfield PJ, Sterne TK, MacMillan JT, Embesi JA, Hickerson EL, Johnston MJ, Schmahl GP, Sinclair J. 2020. Stetson Bank Long-Term Monitoring: 1993-2015. National Marine Sanctuaries Conservation Series ONMS-20-06. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Flower Garden Banks National Marine Sanctuary, Galveston, TX. 156 pp. <https://sanctuaries.noaa.gov/science/conservation/stetson-bank-long-term-monitoring-synthesis-report.html>


Shore, A. N., Sims, J.A., Grimes, M., Howe-Kerr, L.E., Stadler, L., Sylvan, J. B., Shamberger, K. E., F., Davies, S. W., Santiago-Vazquez, L. Z., Correa, A. M. S. 2021. On a Reef Far, Far Away: Anthropogenic Impacts Following Extreme Storms Affect Sponge Health and Associated Bacterial Communities. *Frontiers in Marine Science*. 8:608036. Doi: 10.3389/fmars.2021.608036

Strader, M.E., Aichelman, H.E., Tramonte, C.A. *et al.* Expanding coral reproductive knowledge using remotely operated vehicles (ROV): broadcast-spawning observations of mesophotic corals at the Flower Garden Banks. *Mar. Biodivers.* 51, 70 (2021). <https://doi.org/10.1007/s12526-020-01159-4>

Weerabaddana MM, DeLong KL, Wagner AJ, Loke DWY, Kilbourne KH, Slowey N, Hu HM, Shen CC. 2021. Insights from barium variability in a *Siderastrea siderea* coral in the northwestern Gulf of Mexico. *Marine Pollution Bulletin* 173. <https://doi.org/10.1016/j.marpolbul.2021.112930>

Science Interpretation Activities

1. Good Pitch Texas Lionfish Proposal and Presentation, Oct. 27-28, 2020 (Johnston)
2. Houston Chronicle Sanctuary Expansion interview, March 4, 2021 (Hickerson)
3. Virtual lionfish dissection conducted for St. Andrews Elementary 4th and 5th grade students, Feb. 9, 2021 (Johnston)
4. Laurel Mountain Elementary School Ocean Day presentations, March 12, 2021 (Hickerson)
5. SCTLD interview with Paul Cater Deaton (Hickerson)
6. National Geographic Interview (Johnston)
7. Texas Monthly article interview (Hickerson)
8. Coral Identification and Coral Point Count Ball High Presentations and development of coral monitoring practice package for students (Johnston, O'Connell)

- 
9. Scientific support for exhibition by artist Janavi Mahimtura Folmsbee at Heidi Vaughan Fine Art Gallery, and for installation at George Bush International Airport. (Hickerson)
 10. Response to letters from students – Into the Sea (Hickerson)

Trainings, Meetings, Conferences

1. ABT (And, But, Therefore) training (Johnston/Hickerson)
2. Grant writing training (Johnston/Nuttall/Blakeway)
3. Deepwater Horizon SharePoint Training (Nuttall)
4. Advanced PRIMER 7/PERMANOVA + course (Johnston)
5. CRCP Environmental Compliance Training (Johnston)
6. ONMS Climate Messaging three-part webinar series (Johnston)
7. Coral Collaboration webinar on NOAA/NPS interactive data portal (Research staff)
8. PROTEUS Pilot Training (Nuttall)
9. University of South Florida Workplace Culture and Training Certificate (Johnston)
10. ABT Time Narrative Blitz (Johnston/Nuttall)
11. Microaggressions in the workplace (Johnston)
12. Team building starts with trust training (Johnston)
13. NOAA CoastWatch Training (Nuttall/O'Connell)
14. EndNote 20 (Nuttall)
15. Integrating Climate Resilience Across ONMS (Johnston/Nuttall)
16. SRV-8 Remotely Operated Vehicle training (O'Connell/Nuttall)
17. Virtual Unit Dive Supervisors Conference (Nuttall)



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AMERICA'S UNDERWATER TREASURES