UNIVERSITY OF MIAMI
ROSENSTIEL SCHOOL of MARINE & ATMOSPHERIC SCIENCE

Window To The Sea: Challenges and Success of creating an Indoor Great Barrier Reef

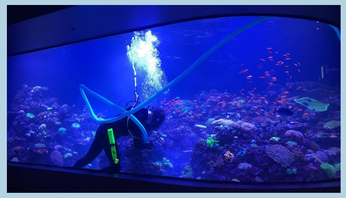
FROST SCIENCE

Joseph Recker

Phillip and Patricia Frost Museum of Science, Rosenstiel School of Marine and Atmospheric Science

Abstract

The Great Barrier Reef is one of the most biologically rich marine ecosystems in the world and serves as an amazing educational tool to discuss global biodiversity and conservation. Creating "mega-reef" aquaria exhibits pose many biological, chemical and physical challenges and restraints to indoor aquarium facilities. The Frost Museum of Science set on an ambitious goal in 2020 to construct one of the largest re-creations of the Great Barrier Reef ever. Over 800 fish from 47 different species, and 1000's of live coral specimens were imported or transferred from other zoological facilities to create a biologically accurate representation of the Great Barrier Reef. Intensive internal exhibit construction including extremely specialized lighting, advanced filtration and proper coral placement had to be done in order to make the exhibit a reality. This project revealed many of the challenges in creating a "mega-reef" aquarium exhibit and best husbandry practices for future facilities to follow when reconstructing coral reef habitats in an artificial setting.

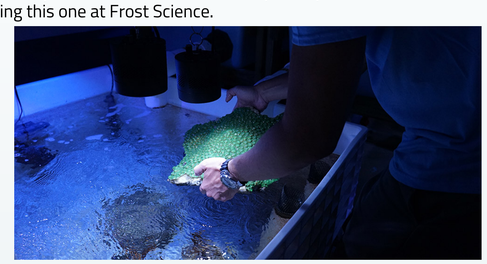


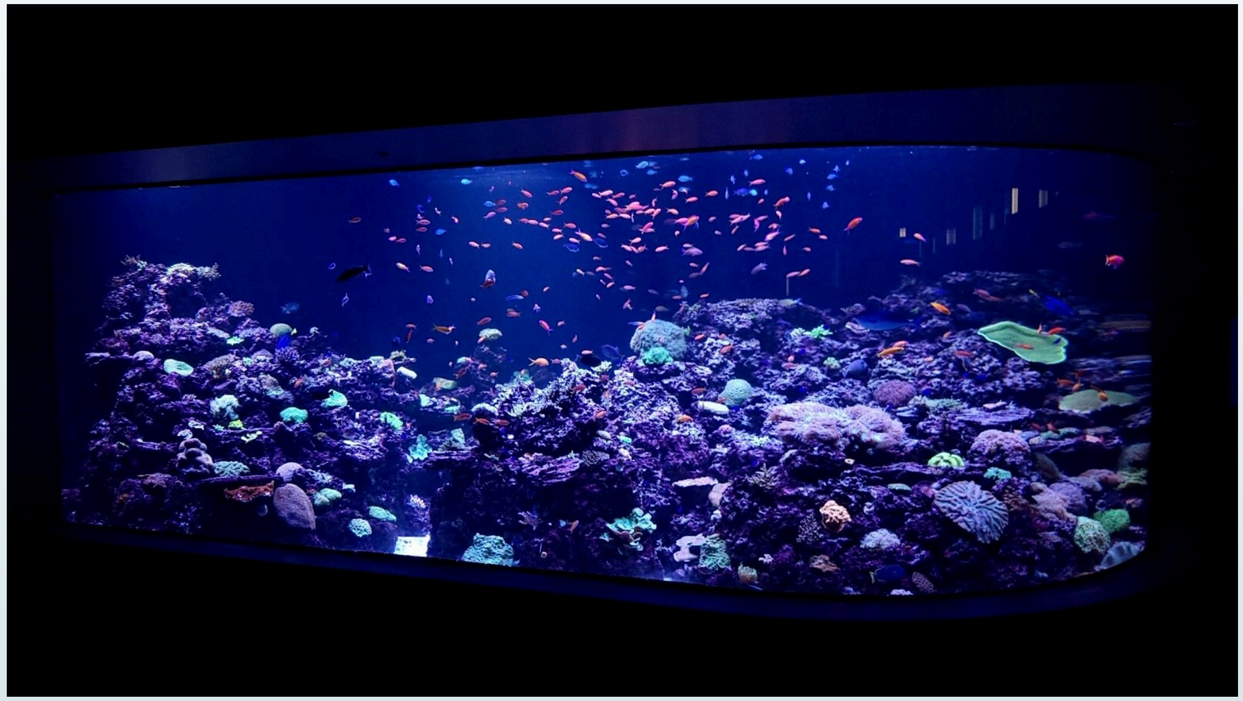
Introduction

The Frost Museum of Science, opened in 2017, is one of the newest and most technologically advanced aquatic scientific facilities ever created. It features over 1 million gallons of living aquatic exhibits seeking to engage 250,000 annual visitors about environmental issues and concerns occurring in the South Florida aquatic region and worldwide. In 2020 Frost Science embarked on an ambitious project of constructing one of the largest indoor re-creations of the Great Barrier Reef in a 10,000-gallon exhibit. This exhibit took several months and intense work to create, including a team of over ten people working over two months to create the exhibit and over a year of livestock acquisition and quarantine. The Great Barrier Reef region was chosen due to its remarkable beauty and variety of different species. It is one of the most diverse habitats on Earth and known worldwide. Because of this immense diversity and unique conservation messaging, it was the chosen region for the exhibit at Frost Science Museum.

Methodology

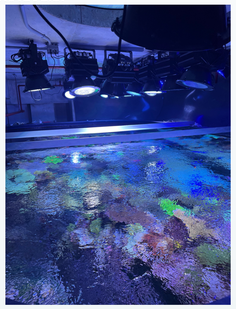
From approximately 2019-2020 coral and fish were shipped to Frost Science Museum from Seaworld Orlando and private companies to help stock the exhibit. All coral and fish went through a rigorous 30–90-day quarantine period to ensure no disease would enter the exhibit. Corals were treated with *Bayer BioAdvanced* Beta cyfluthrin to mitigate pest and stony coral rapid necrosis. All fish were fed commercially formulated diets, and proper eating and health was ensured by biologist and veterinary staff before moving onto exhibit. No live biological material was added to the exhibit in order to ensure minimal pests or disease contamination. 20 high power LED lights were installed above the exhibit to mimic sunlight and programmed to a typical Australian sunlight cycle. An *Aquarium Engineering* Calcium Reactor was installed to maintain extremely high levels of dissolved calcium levels to help with calcium carbonate usage. Filtered ozonated seawater inputted from offshore in Biscayne Bay is used in all exhibits, including this one at Frost Science.





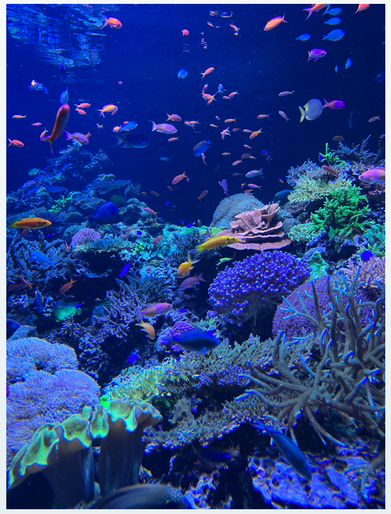
Results

Light stress was the most common issue faced by coral in this exhibit. Many of the coral specimens experienced minor bleaching events due to changes from quarantine to exhibit lighting. Excess dissolved calcium in the water caused there to be more coralline algae growth on glass, requiring additional staff maintenance dives. Cultured phytoplankton was introduced to help feed many of the small polyp stony coral specimens. Tridacna clams had a difficult time in acclimating to the exhibit, most likely due to their delicate nature and size constraints. The artificial seawater did an excellent job at ensuring trace elements and nutrients were high. High levels of phosphate were often recorded, due to the immense amount of food and nutrients for a reef this size. Additional water changes and excess filtration was added to combat the high nutrient levels.



Conclusion

Proper acclimation to light is necessary to ensure coral growth and minimum stress when transferring organisms from a quarantine environment to an exhibit. Use of a PAR- meter is recommended to gauge light levels in various parts of the habitat. Supplemental trace elements and excess calcium is needed in order to maintain optimal coral growth. Nutrients seems to be a common issue among mega-reef exhibits due to their high bio-load and need for food and phytoplankton, excess filtration and increased frequency of water changes seems to be extremely helpful. More aggressive and non-compatible fish species can be kept in mega-reef exhibits due to increase in hiding spots and water volume. Many organisms coming from Australia ship extremely poorly, proper quarantine is crucial to ensure best possible recovery from shipping stress. Swabbing of coral mucosal tissue during quarantine is recommended to examine potential pests under a microscope. Exhibit maintenance diving space needs to be considered for coral exhibits due to their extremely fragile structure. Live coral exhibits seem to be a visitor favorite due to the vibrant colors and diversity of life. They are extremely good marine conservation and educational messaging platforms.



Acknowledgements

Frost Museum of Science Biologist and Veterinary Team

Dr. Marjorie Oleksiak and Douglas Crawford

SeaWorld Orlando

Mote Marine Laboratory and Aquarium

Mastriani Family for their generous funding support with the Mastriani award