3D-Printed Hemp-based Artificial Coral Reefs as Biodegradable Solution for Marine Restoration

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As the third largest coral barrier reef system in the world, the Florida Keys is home to thousands of marine life species and faces a myriad of threats resulting in a 90% decline in healthy corals. The ability to help revitalize coral reefs would provide a vast benefit to marine biodiversity. The purpose of this project was to build a 3D Hemp-based artificial coral reef structure for coral polyps to adhere, grow, and thrive to regenerate a natural reef. It was hypothesized that a Hemp-based structure would exhibit higher biodegradability than a PLA structure and that a gyroid design would biodegrade faster than a fractal design, evidenced by the changes in relative density and prototype mass (grams). Sixteen trials of eight prototypes per filament-type (Hemp/PLA) were split by design (Fractal/Gyroid) with eight coral frags as Control. Micro-CT data supports the hypothesis given that the determination of relative density measured using pixel gray-scale intensity values shows superior decreases in Hemp (-14.13%) versus PLA (-12.62%) density and greater density decrease in gyroid (-14.04%) versus fractal (-12.71%) designs. The SEM internal structural imaging comparison supported a greater qualitative degradation in the Hemp. Additionally, polyps' growth on Hemp, PLA, and Control were 57%, 53%, 48%, with Favia exhibiting greater growth, followed by Acanthastrea and Caulastrae, all showed higher rooting on gyroids. There is great urgency to find alternative ways to restore coral reefs given their threatened survivability. Future work would include placement of prototypes en situ in Florida Keys as part of NOAA's National Marine Sanctuary Rehabilitation program.

Awards Won:
Second Award of $2,000