Enhancing Coastal Resilience Using Biomimetic Wave Barriers

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Strong hurricanes in recent years have brought record-high storm surges to coastal areas in the US. Their devastating effects on life, property, and the environment require continuous efforts to raise the survivability rate in areas where they make landfall. Currently on its fourth year, this project explored biomimetics to design two wave barriers that could weaken hurricane-induced storm surges and mitigate coastal erosion. These were inspired by corals, which are known to reduce wave strength. The first design incorporated the staghorn coral's thick arms, while the second was drawn from the scolymia's round structure, with a vortex hole added in the center. Ground oyster shells were mixed with concrete to produce the barriers, creating a sustainable composite material that could help reduce seashell waste. The barriers were placed on a scale model of the Jacksonville Beach slope in a wave tank, which simulated storm surges approaching the shoreline. A platform beyond the slope represented land. T-tests revealed that the first set of barriers, whose interlocking arms dissipated the passing waves, was statistically significantly more effective in reducing water velocity and wave height. Overtopping occurred as water crashed against the second set, which did not decrease wave height. Despite this, the second set effectively weakened water velocity, preventing the waves from reaching land. Both barriers prevented slope recession, whereas the absence of barriers in the control group resulted in erosion. These findings aim to aid in lessening the damages caused by storm surges and creating more resilient coastal areas in the future.

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