TASI - Transplantation of Corals Using Automated Mechanism for Sustainable Marine Forest and Coral Reef Conservation: An Integrated Approach

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Coral reef ecosystems are rapidly deteriorating as they endure global threats leading to negative economic impacts, loss of cultural understanding and a decrease in habitat and biodiversity. The Commonwealth of the Northern Mariana Islands (CNMI) has lost approximately 90% of its coral due to mass bleaching caused by climate change and pollution. Existing methods such as prediction programs and current transplantation method face limitations, including excessive costs, dependence on human labor, and low post-transplantation survival rates of about 50%. In response, we introduce TASI, an unprecedented autonomous coral transplantation mechanism. TASI is a self-directed network of hexagonal modules that transport corals using real-time LoRa communication. These modules are fabricated from biodegradable PHA via high-resolution 3D printing, replicating natural reef substrate to support coral growth. Enhanced by acoustic attraction technology and guided by a web-based marine data system, TASI facilitates large-scale, diver-free restoration. TASI shifts the paradigm from to automated restoration, utilizing advanced computational techniques to optimize coral larval settlement, ensure structural durability, and improve environmental adaptability, significantly increasing survival rates. Compared to conventional coral transplantation methods, TASI offers practical solutions for large-scale marine ecosystem restoration by achieving cost reductions of up to 70% and transplantation efficiency improvements of 210%. TASI represents a transformative advancement in marine conservation technology with the various potentials. The integration of technology demonstrates that the future of conservation lies not merely in protecting the past but in actively building a resilient future.

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