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Facilitating Coastal Communities through Modular Artificial Reefs: A Scalable and Accessible Design Approach in Thailand

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Abstract

In regions where technical infrastructure and financial capacity are limited, conventional artificial reef (AR) solutions remain largely inaccessible to coastal communities. This study introduces a community-oriented design model for modular artificial reefs (MARs) that promotes decentralized marine restoration by enabling individual users and local groups to participate directly in reef deployment. Developed within a design thinking framework, the MARs system emphasizes lightweight construction, standardized interlocking modules, and environmentally sustainable materials. Prototypes were tailored for transport by small boats and manual installation without the need for cranes, scuba compressors, or other specialized equipment. A pilot project implemented in Chumphon Province, Thailand, demonstrated the feasibility of grassroots-led deployment with local divers and stakeholders. By prioritizing ease of use, adaptability to site-specific marine conditions, and replicability, the project proposes an inclusive reef restoration model capable of supporting marine biodiversity while fostering long-term stewardship among coastal populations. The study contributes a scalable and adaptable design strategy for empowering under-resourced communities in Southeast Asia to reclaim agency in marine conservation.

Keywords: Modular Artificial Reefs, Community-Based Restoration, Decentralized Deployment, Sustainable Coastal Design