Bio-Innovative Sponge to Reduce Cannibalism Behavior for Blue Swimming Crab Conservation and Sustainable Coastal Ecosystems

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This study aims to enhance blue swimming crab larval survival for conservation before release into natural habitats, reducing environmental impact. Blue swimming crabs (Portunus pelagicus) play a crucial role in marine ecosystems and are cultivated in Thailand to increase populations. However, survival rate remains critically low at 1% due to cannibalism, driven by stress from inadequate shelter, food scarcity, and unsuitable physical conditions. Rising seawater temperatures further threaten larval survival. We investigated aggression factors, focusing on physical conditions and shelter availability. It examines light color (red, green, blue, white) and intensity (<1,000, 1,000, 2,200, 3,000 lux), with red light at 1,000 lux achieving the highest survival rate of 22%. A Bio-Innovative Sponge was developed using grinded mussel shells mixed with polylactic acid, designed with porosity structures inspired by Yellow Tube Sponge, Venus' Flower Basket, and Loggerhead Sponge. The optimized ratio of biomaterial mixture was extruded to create functional filaments. The most suitable porosity structure (Loggerhead sponge) and pigmentation (blue) showed the highest survival rate of 33%. When applied in crab banks, these sponges increased survival to 35.9%, 1.5 times higher than the control group in seven days. Aggression levels and survival rates were analyzed using the Deep Learning YOLO algorithm with 3,000+ images, achieving 92% accuracy. Findings confirm that bioplastic sponges enhance shelter availability, reduce stress, and improve survival rates, enabling 1.5 times more P. pelagicus to be released into natural habitats. This aquaculture innovation supports P. pelagicus population restoration, sustainable conservation, and long-term marine ecosystem balance.

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