# THE UNIVERSITY OF HONG KONG
# SCHOOL OF BIOLOGICAL SCIENCES

***Postgraduate Student Public Seminar***

# "ECOLOGICAL RESTORATION OF ARTIFICIAL SEAWALLS VIA ECOLOGICAL ENGINEERING APPROACHES AND THE POTENTIAL IMPACT OF GLOBAL WARMING ON A DESIRABLE ECOSYSTEM FUNCTION"

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**on Monday 26 June, 2023 at 2:30 pm**
**Room 6N-11, Kadoorie Biological Sciences Building**

## Abstract

Shoreline hardening is a widespread phenomenon in which natural shorelines are replaced with coastal and marine infrastructures (CMIs) to protect coastal regions from wave action, flooding, and erosion. About 30% of the world's shorelines are considered "unnatural", and some suggested that this is going to increase by at least 50% in the next 25 years due to sea level rise and the burgeoning coastal population. Unfortunately, traditional CMIs often have poor habitat heterogeneity, biodiversity, and ecological value. This study aimed to investigate the effectiveness of various eco-engineering approaches for ecological restoration of artificial seawalls in three regions in Hong Kong – Ma Liu Shui, Sai Kung, and Lung Kwu Tan/Tuen Mun – and assess the global-scale effect of ocean warming on the biofiltration of habitat-forming bivalves, which is regarded as a desirable ecosystem function in restoration programs.

The hard eco-engineering approach was studied on both vertical and riprap seawalls in the three regions by retrofitting multiple types of industrial-sized precast eco-engineered concrete features to the mid-intertidal zone (i.e., panels of two different surface designs on vertical seawalls; armouring unit and tidal pool on riprap seawalls). After 24 months of deployment, the eco-engineered features harboured significantly higher alpha diversity of epibiota than the controls and exhibited higher unique taxa numbers, leading to distinctive community compositions. Furthermore, the beta diversity of the enhanced seawalls was also substantially greater than other unmodified seawalls of the same type within each region.

Oyster baskets filled with bags of live Hong Kong oysters (*Magallana hongkongensis*) and cured oyster shells were retrofitted to the lower intertidal zone on a riprap seawall in each of the three regions and were tested as a soft eco-engineering approach. Over 100 taxa were recorded within the 18-month monitoring period in each region, and at least 97% of them were present in the oyster baskets, more than double of the controls. Furthermore, the oyster baskets had more unique taxa than the controls (>55% versus <3% of all taxa recorded). However, both the biodiversity and biofiltration capacity of the epibiota were similar between the live-oyster set and the oyster-shell set, possibly due to the high mortality of the live oysters.

A meta-analysis was conducted to examine the global-scale effect of ocean warming on the biofiltration of Mytilidae and Ostreidae, two bivalve taxa commonly used for coastal ecological restoration. The annual mean biofiltration efficiency of the bivalves in 2100 was projected to be slightly boosted compared with the thermal condition in 2019 as ocean warming intensified, except for tropical oysters. However, various degrees of biofiltration inhibition were projected in the warmest three consecutive months, regardless of geographical location and taxon, while the tropical oysters would always be worse off. These projections have significant implications for the planning, management, and outcome of restoration programs utilising these bivalves.

Overall, the results of this study demonstrated that large-scale implementation of industrial-sized eco-engineered features of the hard and soft approaches could effectively enhance bioddiversity and ecosystem functions on artificial seawalls. However, it is important to stress that eco-engineering technology should not be considered as a substitute for natural coastal habitats or mitigation for coastal development because natural shores with highly diverse habitats are unique and often display higher biodiversity that eco-engineering cannot attain.

--- ALL ARE WELCOME ---