MCEF Completion Report

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Project Title: Identifying the Seagrass Conservation and Restoration Priorities in Hong Kong in relation to Anthropogenic Pressure

Project Period: 01/01/2024 to 27/03/2026

Organisation/ Project Leader:

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Executive Summary

This project updated the understanding of seagrass distribution and species presence in Hong Kong by re-investigating the 26 sites identified by the Agriculture, Fisheries and Conservation Department (AFCD) in 2019. Surveys conducted from 2024 to 2025 confirmed the continued presence of all five historically reported species: *Halophila ovalis*, *H. beccarii*, *H. minor*, *Ruppia maritima*, and *Zostera japonica*.

Species-Specific Distribution:

- *Halophila beccarii* is the most widely distributed species, found in 50% of seagrass sites, primarily along the western coast at Pak Nai, Ha Pak Nai, and Sham Wat. Ha Pak Nai exhibits the highest coverage, exceeding 80%.
- San Tau, previously dominated by *H. ovalis*, experienced significant seagrass loss in late 2024. While some natural restoration has occurred, the area remains reduced. *Zostera japonica* is now the dominant species, though *H. ovalis* persists. This shift indicates species succession following disturbance.
- *Halophila minor* is rare in Hong Kong, observed only occasionally and with very low coverage (less than 1%) at Tsam Chuk Wan.
- *Ruppia maritima* appears to thrive in specific conditions, found with *Ruppia maritima* thrives under specific conditions, showing high biomass and coverage in the Mai Po Nature Reserve, which indicates a favourable habitat.

Anthropogenic Impacts and Environmental Factors

Microplastics: Seagrass meadows accumulate microplastics at concentrations two to three times higher than non-seagrass sites. Fibers make up about 63% of these microplastics, indicating that seagrass meadows serve as significant sinks for microplastic pollution.

Nutrient Profiles: Western coastal areas of Hong Kong, such as San Tau and Pak Nai, have higher nutrient levels than eastern regions like Tsam Chuk Wan. Despite elevated nutrient loads, seagrasses show strong resistance to eutrophication. Nutrient concentrations in sediment porewater are higher than in overlying seawater. Ammonia is the preferred nutrient for seagrass, indicating that sediment-bound ammonia may be their primary nutrient source in Hong Kong.

Modelling Seagrass Habitats and Impacts

Two advanced modelling approaches were used to assess seagrass distribution and the factors affecting their health and carbon storage.

1. Partial Least Squares-Path Modelling (PLS-PM)

This multivariate method analysed how anthropogenic impacts, specifically water quality and microplastic pollution, affect seagrass health and soil carbon stock, based on 36 field observations.

Water Quality: Poor water quality, indicated by high nutrient and chlorophyll levels, was a primary factor negatively affecting seagrass canopy structure (reduced cover, density, photosynthetic efficiency) and carbon storage (lower biomass and sediment carbon). The strong negative effect on carbon storage (β = –0.460) highlights the importance of water quality management.

Microplastic Pollution: Microplastics had a significant negative effect on canopy structure (β = –0.312), contributing to seagrass degradation. The direct effect on seagrass carbon was slightly positive (β = +0.127). This unexpected result may be due to microplastic retention in depositional environments that also accumulate carbon, indicating a complex interaction rather than a direct benefit. Soil Condition: Sediment grain size significantly affected seagrass health and carbon storage. Muddy, fine-grained sediments had negative effects on both canopy structure (β = –0.313) and carbon storage (β = –0.314), while sandier substrates supported better seagrass performance.

Canopy Structure: Healthy seagrass canopies positively influenced carbon storage (β = +0.200). However, this indirect effect was less significant than the direct impacts of water quality and sediment, suggesting that stressors reduce carbon sequestration through additional mechanisms beyond canopy loss.

The PLS-PM model explained a significant portion of variability, accounting for about 30% in canopy structure and 60% in carbon metrics, underscoring the importance of water quality. The study recommends prioritizing water quality management for seagrass conservation and carbon sequestration, and advises including sediment characteristics in restoration planning.

2. MaxEnt-based Species Distribution Modelling (SDM)

This method was used to map and predict potential seagrass habitats along the Guangdong and Hong Kong coastlines, using presence-only data and environmental variables. The model showed moderate predictive ability (AUC = 0.59), suggesting that while key environmental factors were included, additional predictors may improve accuracy.

Distance to Shoreline: This was the most significant predictor, contributing 74.3% to model gain. Its strong influence (permutation importance of 84.8%) confirms that seagrasses are mainly found in shallow, nearshore environments where light penetration and wave protection are sufficient.

Chlorophyll-a Concentration: As the second most important predictor (23.5% model gain), chlorophyll-a was negatively correlated with habitat suitability. High chlorophyll-a levels indicate eutrophic conditions with increased phytoplankton, reducing water clarity and light availability, which harms seagrasses. This supports the global understanding that reduced light is a major cause of seagrass decline.

Other Factors: Temperature, salinity, nitrate, and phosphate levels contributed minimally. This may reflect the broad tolerance of seagrasses to these factors or the coarse spatial resolution of the data, which may not capture critical fine-scale environmental gradients.

The spatial predictions from MaxEnt-based modelling are valuable for identifying potential seagrass habitats for conservation and restoration. However, limitations such as sparse occurrence data and coarse environmental resolution highlight the need to include finer-scale predictors, such as substrate composition, turbidity, and human disturbance, to improve model robustness. Overall, the findings emphasize the importance of light availability, coastal proximity, and water quality for seagrass habitats in the Guangdong-Hong Kong region.