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MCEF21007 / MCEF22SC01 Linking coral cover and reef fish diversity in Hong Kong waters using eDNA

Executive Summary

Traditional methods of studying marine life through underwater visual surveys have long been challenging in Hong Kong's waters, where poor visibility and high turbidity make it difficult for divers to accurately observe and count species. This limitation has historically hindered our understanding of marine ecosystems. However, our study using environmental DNA (eDNA) - which works like collecting fingerprints from seawater - has revolutionized how we monitor marine communities, from the smallest microorganisms to fish, offering a comprehensive picture of the entire marine food web. Our research reveals distinct patterns across three natural environmental gradients in Hong Kong's waters, ranging from estuarine, transitional, and relatively oceanic waters. The oceanic waters around Sai Kung emerging as Hong Kong's marine biodiversity hotspot, showing the highest diversity across all studied groups - from microscopic prokaryotes and protists to corals and fish communities.

The study demonstrates that Hong Kong's marine ecosystem is built on complex relationships starting from its tiniest members. We found that prokaryotic communities, dominated by Bacteroidota and Proteobacteria, form the foundation of the ecosystem, with their abundance patterns varying by season and location. Protists, including various algae and single-celled organisms, showed clear seasonal patterns, with certain groups like Chlorophyta dominating Hong Kong Island waters during spring and others like Cryptophyta peaking in winter across all regions. These microscopic organisms play crucial roles in supporting larger marine life, including corals and fish. Our research revealed that areas with diverse prokaryotic and protist communities typically support healthier coral reefs and more varied fish populations, emphasizing the interconnected nature of marine life. We also discovered that environmental factors, particularly temperature and salinity, strongly influence these communities, with different groups showing varying sensitivity to environmental changes throughout the year.

Looking to the future, these findings have significant implications for protecting Hong Kong's marine environment and similar coastal ecosystems worldwide. The study suggests that effective marine conservation must consider the entire ecosystem, from microscopic life to larger organisms. The Sai Kung region (oceanic), with its more stable and diverse communities across all taxonomic groups, represents a crucial area for conservation. For areas experiencing more environmental stress, like Lantau (estuarine) and Hong Kong Island (transitional), different management approaches may be needed to support ecosystem recovery. As climate change and urban development continue to threaten marine ecosystems, this improved understanding of how different marine organisms interact and respond to environmental changes becomes increasingly valuable. Our work establishes a new standard for monitoring marine biodiversity, offering a reliable method that can track changes across all levels of marine life over time. This comprehensive knowledge is essential for developing effective conservation strategies that protect not just individual species but entire marine ecosystems, ultimately contributing to the resilience of Hong Kong's marine environment in the face of ongoing environmental challenges.