THE UNIVERSITY OF HONG KONG
SCHOOL OF BIOLOGICAL SCIENCES

Postgraduate Student Public Seminar

"Coral lipid biomarkers and stable isotope values in the Anthropocene"

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Abstract

Coral reefs generally flourish under nutrient-poor (oligotrophic) conditions, providing significant ecosystem functioning services to human coastal populations. However, recent anthropogenic global change (*i.e.* climate change, eutrophication) are severely affecting coral biodiversity and the diversity of associated marine organisms. Nonetheless, corals have shown species-specific tolerance ranges to these various stressors. Some species of corals are able to survive and reproduce in chronically polluted environments. The main research questions here were how corals are able to thrive during the severe environmental changes of the Anthropocene and whether those surviving corals still provide a robust ecosystem that can prevail and last.

Reef-building corals have a relationship with endosymbiotic dinoflagellates of Symbiodiniaceae (hereafter "symbionts"). These symbionts contribute up to 90 % to the nutrient intake of their coral host through the process of photosynthesis (autotrophy). In addition, corals can obtain nutrients through external feeding on particulate organic matter and plankton (heterotrophy) as well. To investigate the human impacts on the nutritional physiology and biochemistry in the field of coral reef ecology, a variety of sophisticated biogeochemical proxies, namely stable isotope ratios, compound-specific isotope analysis (CSIA), and fatty acid (FA) profiles were applied to both corals and their symbionts separately. Two coral cores were used to trace the history of human impact on near shore reefs in the Western Pacific Ocean. It was found that variations in CS-δ^{15}N are the results of coupling of human activities and precipitation during the two different phases of the El Niño Southern Oscillation (ENSO) climate pattern. Decreased values of CS-δ^{15}N after the Pacific climate shift was due to the decrease human population and infrastructure development which lowered the influx of nutrients into the ocean.

As another proxy, FA profiles were applied to examine the influence of water quality on corals and their symbionts. FA baselines for five symbiotic coral species (*Acropora samoensis*, *Pavona decussata*, *Turbinaria peltata*, *Favites abdita*, *Platygyra carnosa*) were established. It was observed that all five species have statistically discrete FA profiles when separating coral host tissue from symbionts. In addition, species-specific feeding strategies were defined by FA biomarkers. The two most distinct species, *A. samoensis*, a relatively autotrophic, and *P. carnosa*, a relatively heterotrophic species, showed that differences in FA profiles of each species of coral along a water quality gradient are attributed to the specific feeding strategies.

Finally, FA-CSIA was applied to investigate the contribution of autotrophy to the carbon and FA metabolism in these two trophically distinct coral species. The results revealed that carbon incorporation from symbionts to coral host is related with photosynthesis efficiency, which is also species-specific. The translocation of ^{13}C-incorporation in FA from symbionts to coral host occurred rapidly and immediately. These results provide new insights into the mechanisms and limitations of coral metabolism, allowing for assessment of the overall health of a coral reef ecosystem under the pressure of anthropogenic impacts. This further enables us to determine the general state of health of coral reefs under environmental changes that can complement monitoring efforts.

--- ALL ARE WELCOME ---