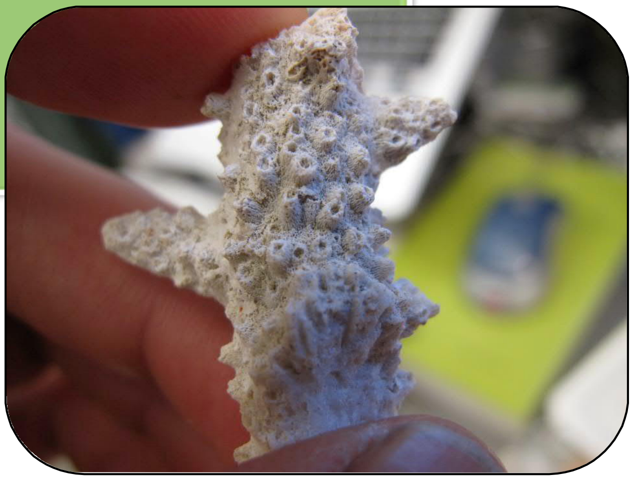
The University of Hong Kong
School of Biological Sciences

Public Seminar

"Hong Kong's coral assemblages through time – a paleoecological and geochemical look at human-driven change"

Mr. Jonathan D. Cybulski

for the degree of Doctor of Philosophy



Date: 17 February 2021 (Wednesday)
Time: 9:30am – 10:15am
Venue: KBSB 6N-11 or Zoom (link upon request)

About the speaker:

Jonathan Cybulski is a PhD candidate supervised by Dr. David M. Baker and Dr. Moriaki Yasuhara. His current research focuses on the historical ecology and biogeochemistry of coral communities.

Abstract:

Corals are unique animals that have formed a nutritional symbiosis with algae, allowing them to access both heterotrophic and autotrophic resources. They calcify external skeletons, which in turn build up and forms coral reefs. These skeletons are made of both inorganic and organic constituents, which are preserved over geologic timescales. These can then be collected, identified, and exploited geochemically in order to piece together ancient environments. All-in-one, corals are animals, engineers, and archives.

Yet corals are also sensitive, and the habitats they form are being degraded worldwide. Regional anthropogenic and global climate stressors are decreasing both live coral cover and coral diversity at an alarming rate. Without conservation and restoration, certain coral reef ecosystems may be lost forever. But it is important to set considered goals when strategizing ecosystem restoration, otherwise functions may not be restored and reefs may continue to degrade. Conservation efforts require a keen understanding of both coral physiology and their ancient contexts. However, the information that corals harbour is rarely studied across varying spatial and temporal scales.

In this thesis, I use a wide suite of paleoecological and geochemical methods in order to investigate the impact humans are having on corals. I created the first paleoecological baseline of coral diversity in Hong Kong, identifying a significant drop in biodiversity, and range contraction over that last 5000 years. Furthermore, I found that modern communities are presently limited in their growth by severe eutrophication. I then used stable isotope analysis to investigate coral nutrient partitioning and their metabolic processes that control fundamental biomolecule synthesis. I determined that their algal symbionts are a nitrogen sink under normal nutrient conditions, and further emphasized the importance of heterotrophically obtained nutrients to the holobiont. I also determined that corals have the ability to synthesize amino acids and fatty acids preferentially from different inorganic and organic nutrient sources. Combined, these findings highlight the adaptative capabilities of the coral holobiont to exist on a range of mixotrophy, and meet its metabolic demands in various ways. I also investigated the late-Holocene nutrient history for Hong Kong, using an in situ nitrogen-isotope signal preserved in coral skeletons. I determined that a recorded δ15N anomaly during the 1980's was novel over that last 7000 years, it was caused by human development and associated increases in sewage, and caused the recent collapse in coral communities. Investigating corals on these varying scales – temporal, spatial, and cellular – unveiled novel insights into their nutrient partitioning and metabolic preferences, and highlighted poor water quality as the major stressor to alleviate for Hong Kong corals today.