**Anthozoan response in high *p*CO2 marine environments**

Rael Horwitz1, 2

Supervisor: Prof. Maoz Fine1, 2

*1The Mina and Everard Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan 52900, Israel*

*2The Interuniversity Institute for Marine Sciences, Eilat 88000, Israel*

Rapid global climatic changes are evident in our era, primarily due to intensive anthropogenic industrial activity. Increasing carbon dioxide (CO2) emissions drive ongoing ocean acidification (OA) and threaten the future of coral reef ecosystems. Anthozoans, both calcifying (e.g. scleractinian corals) and non-calcifying (e.g. sea anemones) species, are subjected to excursions from their optimum leading to biogeochemical and physiological impacts. Although this field of research is receiving much high-profile attention, many aspects of the effect of OA conditions on anthozoans have previously been lacking. My PhD research used manipulative laboratory and field experiments to investigate organism-, population- and community-level responses of anthozoans under OA-like conditions. Common Indo-Pacific coral species from the Gulf of Eilat, Israel, were subjected to high CO2/low pH in a seawater flow-through system to examine regeneration and competitive interactions. In addition, a field study was carried out to examine the response of sea anemones to OA conditions imitated *in situ* by natural marine CO2 volcanic vents at Vulcano Island, Sicily (Italy).

Regeneration post-injury of all coral species was significantly higher in normal seawater conditions as compared to high CO2 treatments. Reduction in regeneration rate, however, was more pronounced in slow-growing massive coral species than the relatively fast-growing, branchingspecies. The major finding is that although regeneration severely declined under increased CO2, this life-preserving process was maintained. Overall, we revealed that under elevated CO2 different coral species inflicted with injury may fall into either CO2-tolerant or -sensitive groups, ultimately affecting the capacity of a reef to recover following physical disturbance.

Competition for space among reef-building corals is an important determinant of community structure and composition and, therefore, of the productivity of reefs. Information about OA effects at the community scale, such as the dynamics of species interactions, has previously been lacking. Our year-long study demonstrated that under acidified conditions there are changes in competitive interactions within and between reef-coral species compared to present-day conditions. Based on the experimental results, we used a general model of space competition which showed shifts in the dominance hierarchy and long-term projected loss in coral cover under ocean acidification conditions. Collectively, we reveal that as pH declines, some reef-coral species may benefit from increased competitive performance while others lose out. Shifting winners and losers of reef space under increasing OA will in all likelihood change the composition, structure and functionality of coral communities.

Sea anemones were sampled in a field study along a natural CO2 gradient nearby volcanic vents at Vulcano Island, Sicily (Italy). Results revealed significantly higher algal reproduction (mitotic index of the algal symbionts) at higher CO2 sites when compared to ambient conditions. Stable isotope analysis of carbon indicated a greater net autotrophic input to the anemone carbon budget under acidified conditions and utilization of the lighter carbon isotope for photosynthesis. This non-calcifying anthozoan was characterized by a higher autotrophic/heterotrophic ratio as CO2 increases. There were no significant changes in nitrogen isotopic signatures and C/N ratios along the CO2 gradient. This species' unique trophic flexibility may give it a competitive advantage and enable its potential adaptation and ecological success in future seas under OA.

The findings of my research point to major impacts of OA on anthozoan life functions, and the possibility that calcifying and non-calcifying species may respond differently. Such diversity of responses is perhaps not surprising since other factors likely regulating "fitness", namely the role of calcification, may account for these differences. Understanding how this group of organisms responds to OA, and the combination of factors that drive "success" or "decline" alongside increased CO2, will be an essential component of confidently predicting the future form and function of benthic ecosystems.