The Effect of Ocean Acidification on Calcification of *Acropora milliepora*

W.C. Chou[1] , Y.M. Lin[2]

1. National Taiwan Ocean University, Institute of Marine Environment and Ecology

2. National Taiwan Ocean University, Department of Bioscience and Biotechnology

Introduction

Results of extensive research over the past decade has led to increasing concern that rising atmospheric carbon dioxide(CO2) concentrations will cause changes in the ocean's carbonate chemistry system with a resulting impact on calcifying marine organisms. The oceans absorb CO2, resulting in surface water increases in dissolved inorganic carbon and decreases in pH and carbonate saturation state. The lowering of ocean pH due to increasing atmospheric CO2 has been termed ''ocean acidification''. Marine calcifying organisms may experience increasing difficulty in secreting their skeletons as ocean pH decreases and the consequences may be severe for many marine ecosystems including coral reefs. In this research, we established three different artificial environments and address the direct effects of seawater acidification on coral calcification.

Materials and Methods

Three 0.455 x 0.455 x 0.455 m tanks marked as 1, 2, and 3 were supplied with artificial seawater, all three tanks are equipped with l ights turning on and off regularly according to the approximate sunrise and sunset time in summer Keelung. Protein skimmers and pH meters are added in each tank, only tank B and tank C are equipped with CO_2 tanks, coolers, heaters, and pump in order to control their temperature and pH. All tanks are controlled and monitored by Apex Controllers. Ca^{2+}, NO_3^-, KH, and PO_4 are measured in all three tanks at least once per week in midday, and are all controlled within acceptable range. pH in tank B is set in 8.20 (±0.8) in order to simulate real ocean environment, and tank C is undergone ocean acidification with its pH set in 7.80 (±0.5); all pH is controlled by CO_2 and air pumps. Temperature is measured every 10 minutes and controlled by heaters and coolers around 25.0℃ (±0.8) in tank B and C, while temperature and pH are measured but not controlled in tank A. The coral growth experiments used the coral *Acropora milliepora*, which is divided into nine pieces as nine different labeled samples.Three samples are added in each tank, and are all undergone buoyant weight measurement with the use of precision balance. The time period for sampling is not equal (3 and 4 days). (Fig.1)(Fig. 2)

Fig. 1 Cut coral is applied with special underwater glue which allows them to stick to the labeled bases hung by fishing thread at particular spots labeled as A, B, and C; each sample is keep at the same height in case to receive same amount of light.

Fig. 2 Weight of samples is measured with precision balance with buoyant weight measuring technics every three days and all data are recorded.

Result

In tank 1 where pH and temperature are not controlled, calcification is less obvious, and growth rate is the lowest among three tanks, while in tank 2 with its pH set around 8.20 and temperature controlled at 25℃, growth rate here is the highest. Growth rate in tank 3 is at the second place, around 0.8% with its coral inside affected by ocean acidification (pH 7.80). (Fig.3)

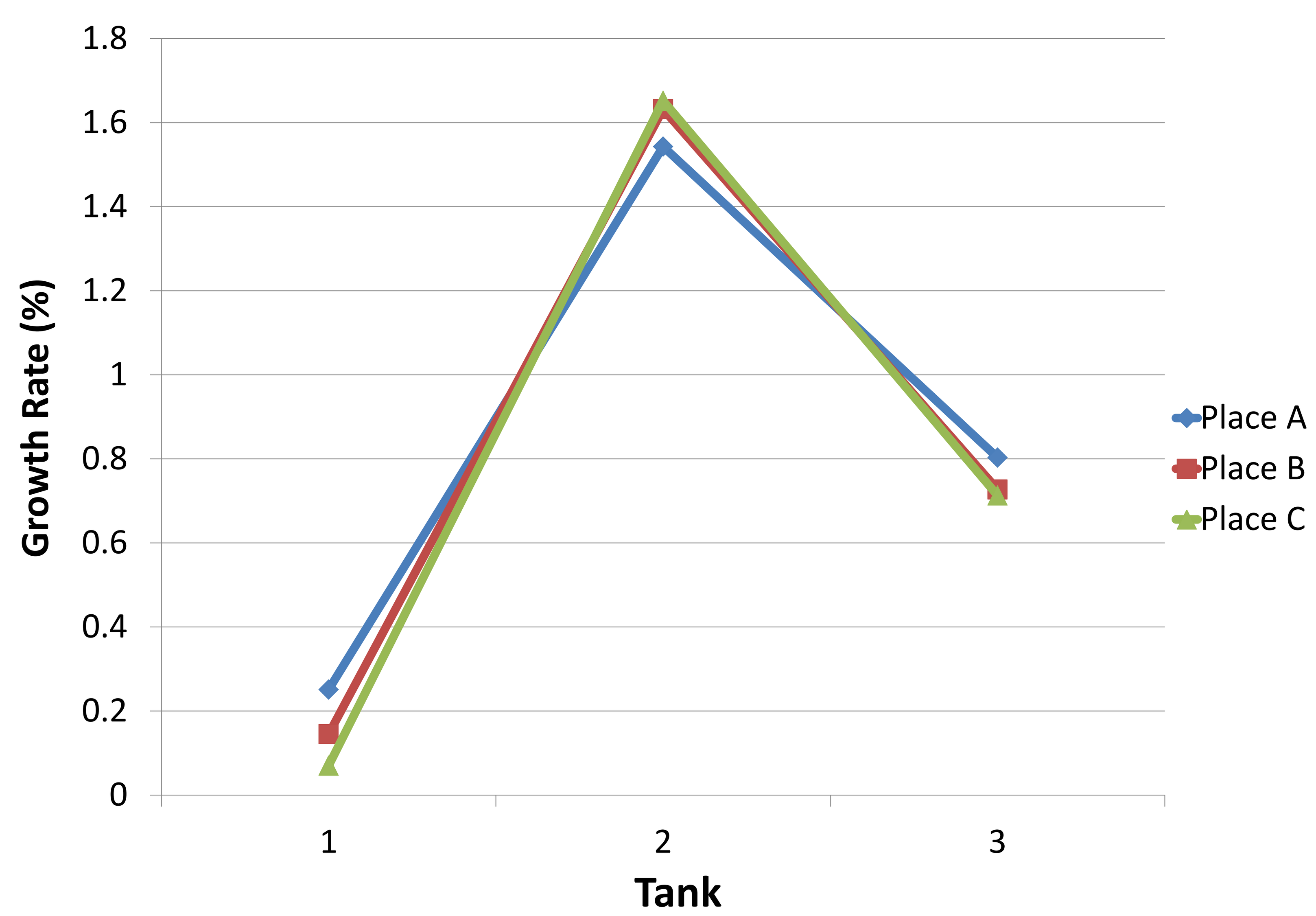

Fig. 3 *Acropora milliepora.* Growth rate (%) over the 20 days experimental period.

Discussion

Does ocean acidification affect calcification?
According to the experiment, growth rate in tank 3 is considerably lower than that in tank 2. This result may refer to the effect of ocean acidification, proves that lower pH can affect calcification of *Acropora milliepora* and has a negative influence, higher pH enviornment is more suitable for calcification organisms.

Acknowledgements

This work is supported by members of Chou's lab of Institute of Marine Environment and Ecology, National Taiwan Ocean University.

References

P. L. Jokiel, K. S. Rodgers, I. B. Kuffner, A. J. Andersson, E. F. Cox, F. T. Mackenzie (2008)Ocean acidification and calcifying reef organisms: a mesocosm investigation.

Fabry, V. J., Seibel, B. A., Feely, R. A., and Orr, J. C. (2008). Impacts of ocean acidification on marine fauna and ecosystem processes. – ICES Journal of Marine Science, 65: 414–432.

Jürgen Herler , Markus Dirnwöber (2011). A simple technique for measuring buoyant weight increment of entire, transplanted coral colonies in the field.