

Is warming beneficial for seagrass and coral co-existing ecosystem to face the threat of ocean acidification?

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Introduction

Recent studies suggest coral reefs live near seagrass beds have higher Ω_{Ar} , may become the refuge of coral facing ocean acidification and warming in the future. In the future, ocean is acidifying and warm environment, and coral reef system is a sensitive ecosystem to ocean warming. Highly productive seagrasses often live adjacent to or near coral reefs. Seagrasses utilize a large amount of inorganic carbon, thereby increasing pH and Ω_{Ar} may enhance coral reefs resilience to future ocean acidification and warming. Warming is found beneficial growth of seagrasses. Therefore, the purpose of this study use mesocosm to understand seagrass beds benefit coral ecosystem facing ocean warming or not in the future.

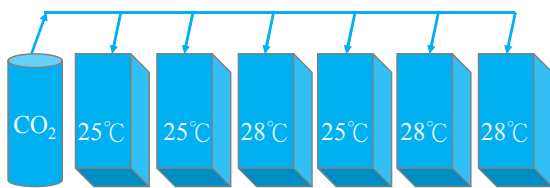


Why we use mesocosm?

Experimental Attributes	Aquarium Studies	Mesocosms	In Situ Investigation
Natural Realism	*	**	***
Control Over Carbonate System Parameter	***	***	*
Multiple Drivers	***	***	*
Cost	**	***	**
Replication	***	***	*
Low* $\xrightarrow{\hspace{10em}}$ High***			

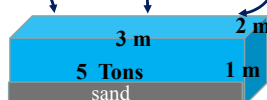
Refer to Andersson et al. (2015)

Experiment Design



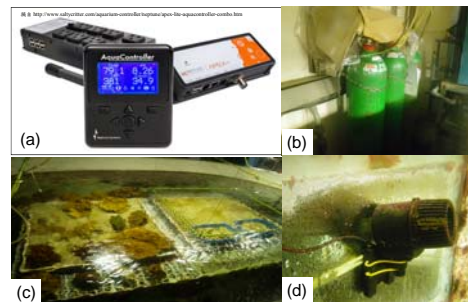
Manipulated and Control Variables	pH: 7.9	Light: 10,000 Lux (07:00~17:00)	Residence time: 4 Days
Biota (Simulated coral reef ecosystems of Nanwan)	Coral: 6 specieses	Seagrass: <i>Thalassia hemprichii</i>	Other organisms: Sea urchin · Sea cucumber · Cleaner shrimp · Damselfish · Goby...

corals seagrasses other organisms



Acknowledgements

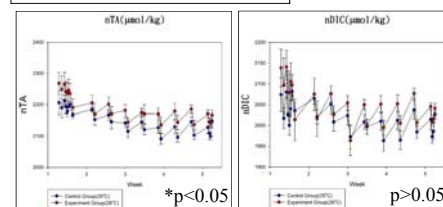
This experiment was supported by Ministry of Science and Technology of the Republic of China (grant no. 105-2815-C-019 -002 -M and MOST 104-2621-B-259-003)



(a) Aquacontroller system,
(b) CO₂ gas Cylinder,
(c) Experiment Tank Design,
and (d) Wave Pump

Results

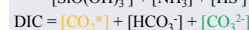
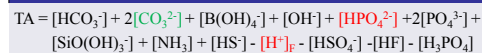
Dependent Variables



Parameter	Average
TA (μmol/Kg)	higher 1.85%
Ω_{Ar}	higher 4.52%
NCP (μmol/Kg 12hrs)	higher 50.2%
NCC (μmol/Kg 12hrs)	higher 23.9%

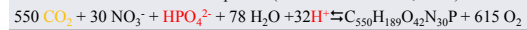
Normalized to 33.61 psu and 26.8°C (average salinity and temperature)

NCP&NCC Calculate



Net community production (NCP)

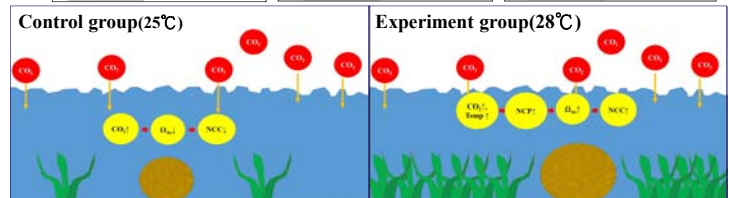
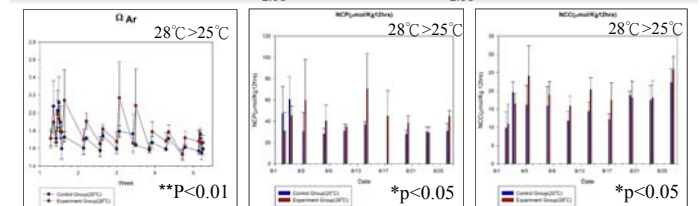
C:N:P ratios of benthic marine plants (Atkinson and Smith, 1983) :



Net community calcification (NCC)



$$NCP = \frac{\Delta TA - 2 \Delta DIC}{2.06} \quad NCC = \frac{-\Delta TA - 0.06 \Delta DIC}{2.06}$$



Conclusion

- (1) Experiment group (28°C) Ω_{Ar} increased of 4.52%, the daytime net community production (NCP) increased of 50.2%, and the daytime net community calcification (NCC) was higher than the control group 23.9%.
- (2) This study proves warmer environment can help seagrasses become to refugia when coral ecosystem under ocean acidification in the future. (different only coral ecosystem under ocean acidification)
- (3) Therefore, maybe seagrass meadow will become a potential tool in coral reefs management at a local scale in the future.