

## ***Interactive comment on “Symbiosis increases coral tolerance to ocean acidification” by S. Ohki et al.***

**S. Ohki et al.**

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Authors response to Anonymous Referee #2 comments:

We appreciate your constructive comments on our manuscript entitled: “Symbiosis increases coral tolerance to ocean acidification”. It was recommended that we undertake some changes to the manuscript; the revised version of manuscript is also attached as a supplement pdf file so that the referees can see the changes that were made. Below we summarize our responses to the comments in a point-by-point form. We hope that our responses are judged to have adequately addressed the points made by the reviewers, and that the paper is now acceptable for publication in Biogeosciences.

“This paper addresses a very interesting topic of coral calcification under ocean acidifi-

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cation conditions. However, the title of the paper “Symbiosis increases coral tolerance to ocean acidification (OA),” misleads the reader. Instead the paper really addresses the effects of ocean acidification on the calcification of coral recruits. The implied “tolerance” isn’t really addressed but instead calcification rates of coral recruits with and without symbionts is the focus of the study. Increased tolerance would imply the effects of OA were diminished for symbiotic recruits relative to aposymbiotic recruits. However, there was no statistical difference between aposymbiotic recruits in OA treatments. The differences in calcification are still noteworthy and there is a large body of work pertaining to light enhanced calcification to aid in this discussion. Overall, this paper is still a valuable addition to the field of coral physiology and climate change. In addition to the above issue, I recommend the following changes:”

> According to your suggestion, we changed the title as “Calcification responses of symbiotic and aposymbiotic corals to near-future levels of ocean acidification”.

1. Page 7015 line 8-10 – A recent paper (Comeau et al 2013b) would be a valuable addition to the discussion of carbon source utilized during coral calcification.

> We cited the paper and added explanation as follows: “ It has also been suggested that both the carbonate and bicarbonate ions affect coral calcification under acidified seawater condition, but the extent of the effect differs in light and dark conditions (Comeau et al. 2013).”

2. Page 7016 line 22 – Were any in situ light measurements taken from the reef flat where the adult colonies were collected? Dufault et al. 2013 found contrasting effects of pCO<sub>2</sub> on calcification and survival of newly settled coral recruits at various light intensities.

> Coral planulae, of most corals including *Acropora*, often recruit into low-light, cryptic habitats and as they grow extend into high irradiance environment. The light levels used in our experiment were designed to be low, and were lower than those in natural conditions where the adult colonies were collected. Although we have previously used

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higher light levels for coral rearing experiments, however, considering the fact that all fragments showed positive calcification in all treatments, suggests that the present light levels seem to be adequate in our experimental condition.

3. Page 7015 line 23 – I would argue that the use of bubbling CO<sub>2</sub> is now standard in published ocean acidification studies. The discussion of acid vs gas bubbling doesn't really benefit the introduction.

> According to your suggestion, we have removed the discussion of acid vs. gas bubbling from the revised version of manuscript.

4. Page 7018 line 1 – Similar to the previous comment, were any in-situ pCO<sub>2</sub> measurements taken where the adult colonies were collected? Several studies (Ohde and Van Woesik 1999, Kayanne et al. 2008, Bates et al. 2001) have documented large shifts in pCO<sub>2</sub> reefs, some of which were taken within the Ryukyu Islands. Knowledge of current reef conditions may inform the growth trends presented in Fig. 2.

> We referred to Ohde and Van Woesik 1999 and to Kitada et al. (2006), which reported diurnal variation of pCO<sub>2</sub> in reef water in front of our laboratory Sesoko Station of the University of the Ryukyus. We added the description on the consideration for pCO<sub>2</sub> variation in the revised manuscript (p. 13, L. 266-).

5. Page 7022 line 1-2 – Dufault et al. 2012 found similar results of coral recruits being unaffected by high levels of pCO<sub>2</sub> in experimental treatments.

> In our experiment, we found that high pCO<sub>2</sub> concentration did not affect adult coral calcification although the calcification of juvenile corals was clearly reduced. Related to the comment on 6 below, we cited the Dufault et al 2012 paper and added some descriptions on that. Please see the reply to comment 6 below.

6. Page 7022 line 10-13 – There is a growing body of literature addressing the effects of ocean acidification on newly settled coral recruits, none of which were discussed (Albright et al. 2008, Albright and Langdon 2011, Albright 2011, Cohen et al. 2009, de

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Putron et al. 2011, Dufault et al. 2012, Dufault et al. 2013). Comparing your results to some of these would greatly aid the discussion.

> We cited the papers and added some descriptions in the revised manuscript (p. 12, L. 243-247): “The same possibility was suggested by other recent studies (Albright et al., 2008; Cohen et al., 2009; Suwa et al., 2010; Albright and Langdon, 2011; Albright, 2011; de Putron et al., 2011; Dufault et al., 2012; Doropoulos et al 2012; Dufault et al., 2013) although comparative studies between aposymbiotic and symbiotic primary polyps is only in its infancy (Inoue et al. 2012; Tanaka et al., 2013)”

7. Fig. 2. Is it possible to use standardized rates of measuring calcification? The relative values limit the reader comparing your results to other published rates.

> We added data on the increase of skeletal weight per day in supplementary data, together with net CaCO<sub>3</sub> deposition rates (Fig. S1). We think this information would be informative to compare our data with other researches' data.

It was recommended to do some changes in manuscript so the revised version of manuscript is also attached as a supplement pdf file for referees to see the changes.

Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/10/C4513/2013/bgd-10-C4513-2013-supplement.pdf>

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