Review of Legrand et al. Species interactions can shift the response of a maerl bed community to ocean acidification and warming

We thank the referee for the constructive comments. We considered all the suggestions and improved the manuscript accordingly. Answers are in red color.

General Comments

The paper by Legrand et al. describes an elegant mesocosm experiment testing the effects of ocean warming and acidification upon the community-scale responses of maerl bed assemblages. This work is timely, and provides an interesting insight into how the communities associated with coralline algae will respond to the impacts of anthropogenic climate change. Given the importance of coralline algae as a habitat architect, and the role of these communities in carbon fixation, I believe this work will make an important contribution to our understanding of coastal sea biogeochemistry. The statistical analysis, however, leaves a lot to be desired and as such, I cannot confidently review the authors' interpretation of their results or discussion. I am baffled as to why the authors have chosen to use permutational multivariate analysis of variance (perMANOVA) of similarity matrices (Euclidean distance) as a statistical test to test for differences in univariate response variable (e.g. respiration). Firstly, the authors make the erroneous assumption that perMANOVA does not make any assumptions about normality and homoscedacity of the data. However. Anderson (2001) point out in their papers describing these methods that the method makes the assumption of multivariate normality as measured by a homogenous dispersion of the similarity matrix data. Secondly, I simply cannot understand why perMANOVA was selected as a statistical test. There are more appropriate univariate tests such as analysis of variance (ANOVA) [with appropriate transformations applied], or if appropriate the use of Generalised Linear Models or Generalised Least Squares techniques which would allow the author to account for non-Gaussian data distributions (GLM) or heterogeneous variances between the treatments (GLS) (see Zuur et al., 2009). This represents a major issue with the handling of the experimental data, and so I cannot recommend the paper be accepted for publication in its current form. I strongly encourage the authors to revise the paper and resubmit. I think this has the potential to be an excellent paper and I will happily review a suitably revised manuscript.

Answer: As suggested, the statistical design has been modified in the m/s and is described in the section "2.5. Data analysis" (P. 9 Lines 191-197):

"Comparisons in species and assemblage physiological rates between the winter and summer seasons was performed using t-tests, after checking the normality and homogeneity of variances. The influence of temperature and pCO_2 was tested on metabolic rates of grazers (*P. miliaris*, *G. magus* and *J. exasperatus*), living and dead maerl, epiphytic biomass and assemblages. Normality of the data and variance homogeneity were checked for all variables. When assumptions were respected, two-way ANOVA were performed, using temperature and pCO_2 as fixed orthogonal factors. When assumptions were not respected, two-way non-parametric Scheirer-Ray-Hare tests were run. Statistical analyses were conducted separately for winter and summer experiments in order to keep a balanced design."

Specific Comments

Abstract

Pg. 1 L 11: "However, little information is available on the response of marine communities…" I do not believe this is true. There has been considerable work of community scale responses to OA – see Ulf Riebesell's work on planktonic communities and bentho-pelagic coupling as an example.

A: We have specified "benthic communities" in the abstract. (L. 11)

Introduction

Pg. 2 L 34-35: Please specify examples of how species interactions are modified by climate change.

A: "Species interactions are a key element in ecosystem functioning and are likely to attenuate or amplify the direct effects of climate change on individual species (O'Connor et al., 2011; Hansson et al., 2012; Kroeker et al., 2012)." (L. 35-36)

Pg. 2 L 37: There are actually quite a number of studies examining the effects of climate change on marine communities. I recommend the authors carry out a thorough literature search.

A: We have reworded the sentence to reflect the growing interest of researches on benthic communities: (L. 36-39) "Most research on benthic ecosystems has focused on the impact of ocean acidification and warming on the response of single species (Yang et al., 2016) and

despite a growing interest, studies examining the effects of climate change at the community scale are scarce in the literature (Hale et al., 2011; Alsterberg et al., 2013)."

Pg. 3 L 61-63: "Because the responses of species…" This sentence seems rather poorly structured consider revising to clarify.

A: The sentence has been clarified: (L. 62-64) "Because the response of species and communities to climate change is likely to vary depending on seasonal changes in environmental factors, such as light intensity, photoperiod and temperature (Godbold and Solan, 2013; Martin et al., 2013; Baggini et al., 2014), it was tested in both winter and summer conditions."

Materials and Methods

Pg. 4 L 90 – 97: This should be a single paragraph.

A: Done

Pg. 5 L 100-109: This information would be better displayed as a table.

A: A new table (Table 1) shows the different pCO_2 and temperature conditions used for winter and summer experiments.

Table 1. Summary of the four experimental treatments. Two pCO_2 (ambient and high pCO_2) and temperature (ambient and high temperature) conditions were tested. High pCO_2 (H-pCO_2) corresponded to a pH decrease of -0.33 units compared to ambient conditions (A-pCO_2). High temperature (T + 3°C) corresponded to a temperature increase of 3°C compared to ambient conditions (T).

	pCO_2	Temperature	
1 (Control)	Ambient (A-pCO_2)	Ambient (T)	A-pCO_2; T
2	High (H-pCO_2)	Ambient (T)	H-pCO_2; T
3	Ambient (A-pCO_2)	High (T+3°C)	A-pCO_2; T + 3°C
4	High (H-pCO_2)	High (T+3°C)	H-pCO_2; T + 3°C

Pg. 9 L 190 – 201: Please revise around appropriate statistical tests.

A: The statistical design has been changed as discussed above.

Discussion

Pg. 11 L 251-253: "Results show… underlying maerl." This sentence is not clear, please specify the community responses to climate change more clearly.

A: (L. 254-256) "Results show that predicted changes may alter interactions among calcifying and fleshy macroalgae via overgrowth of epiphytic algae and an increase in competition for light and nutrients with underlying maerl."

Pg. 16 L 358-359: The final line of the paper is vague, what specific pieces of further work would be useful?

A: The sentence has been reworded: (L. 378-381) "In order to better understand the consequences of climate change on ecosystem functioning, further work should focus on the response of marine communities and consider more specifically shifts in species interactions, including changes in trophic interactions between algae and grazers."

Figures

In the figures it would helpful to see which treatment effects are statistically significant, can you please find a way to highlight these effects in the graphs.

A: Following the suggestion of Referees #1 and #2, statistically significant results have been added on graphs: (L. 197-198) "When 2-way AVNOVAs showed significant results, post hoc tests (Tukey honest significant difference, HSD) were performed to compare the four treatments." Results have been added on corresponding graphs. The direction of changes have also been added in tables (Tables 4, 5, 7 and 8) and interaction plots (in supplementary material) when a significant interaction between pCO_2 and temperature was detected.