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Interactive comment on "Impact of diurnal temperature fluctuations on larval settlement and growth of the reef coral *Pocillopora damicornis*" *by* Lei Jiang et al.

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General comments

In their manuscript titled "Impact of diurnal temperature fluctuations on larval settlement and growth of the reef coral Pocillopora damicornis," the authors present research on an exciting and timely topic – the effect of temperature variability on thermotolerance of two life history stages of a common reef-building coral. The topic is within the scope of the journal and the focus on effects of environmental variability is still novel within the coral field. Unfortunately, I find that this paper is not suitable for publication in its present form. There are several general ways in which this manuscript can be improved.

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1. The Introduction should include a description of the study species and of their reproduction (brooding) and the fact that the larvae contain symbionts upon release. These are critical pieces of information that the general readership of Biogeosciences will likely not know and are important for properly interpreting the results.

2. The Methods needs a much better overall description of the experimental design. It is difficult to tell if the spat were from the same or separate trials. Furthermore, the experimental design is flawed because it does not include replication of the treatments and the culturing techniques are not shown to avoid imposing artifacts on the responses of the corals.

3. The statistical tests and results need to be fully described. Posthoc analyses are not described. Table(s) with full results of all statistical models should be included, including results of posthoc analyses.

4. More synthesis and integrative discussion is needed across all the responses measured to inform a broader picture of the implications for the ecology of this coral. The authors need to place their results in the broader context of biogeosciences and coral reef ecology.

Specific comments

Introduction

L58-59 – "sea surface temperature have increased on average by 0.7deg C"...since what date? A frame of reference is needed here.

L65-70 – it would be good to cite studies that have quantitatively analyzed temperature variability for coral reefs here like Rivest and Gouhier, 2015 and Guadayol et al. 2014

L77-79 – actually, there are a handful of studies (at least 7) that have looked at the effects of temperature variability. I do see that the authors have described the results of a few of these studies in the next paragraph, but they should rephrase this sentence to better define the knowledge gap that their study aims to fill.

L83 – “more suited” is vague and confusing. Please be more specific here.

L84 – “deleterious effects” of what? Diel temperature oscillations?

L86 – “under diel temperature oscillations” compared to what?

L90-93 – this statement needs references.

Methods

L126 – the date of collection of adult corals and the holding conditions of the corals prior to larval release need to be included. The temperature of the water at which the larvae were released should be included.

L129 – “the recruit experiment” – is this the settlement or post-settlement experiment? This should be more clearly defined using a phrase like “to test the effects of xx on yy, larvae were transferred”. This is confusing to the reader because the authors have not defined what settlers or recruits are. Remember – the audience is general and interdisciplinary. Or perhaps it would be more clear to describe more generally that the larvae and settlers are being tested in completely separate experiments?

L130 – were the dishes covered? Did the authors account for/measure effects of evaporation on salinity? Did the authors measure the temperature in the floating dishes during this time? Was there selection that could have influenced the performance of the spat? Again, “spat” is another new synonym used. Please choose one term for the juvenile corals, define it clearly for the reader, and use it consistently throughout the text.

L135 – “ambient temperature” where? At the collection site of the adult corals?

L153-155 – these are results and should be moved to that section.

L155 – how was salinity checked?

L159-162 – these are results and should be moved to that section.

L162 – it is a significant limitation that the experiment has no true replication. I understand and empathize with the frustrations of facility and logistical constraints but more justification is needed for the validity of the results. Could the authors repeat the experiment to replicate the results in place of replication during the experiment?

L166 – the title “Settlement assay” makes me think that the authors are going to be testing effects on settlement and is confusing with “preparation of spat” in the title of the last section. Please revise.

L168 – is this species of CCA a natural settlement substrate for this species in your location? Please provide additional details here.

L170 – did the dishes have lids? Were they sealed in the treatment tank (“submerged”)? What was the depth of the water in the dishes? It seems like a very high spat density in a small volume of water. Please provide justification that these are natural and representative settlement conditions for this species.

L180 – where did these spat come from? Were they from the “settlement assay” or from “preparation of spat”? Were they kept in the four treatments during this time? I can’t interpret the results of these tests without knowing these important details.

L194-195 – describe the settings for photography and illumination to allow others to replicate your measurements.

L198 – the statistical comparison needs to be described here. What were the controls? Was the bleaching index assessed as relative to corals in the control treatment or was it a comparison of absolute values?

L201 – which recruits? The ones assessed for bleaching? Different ones?

L213 – details of posthoc analyses need to be included.

Results

L229-230 – is this ‘normal’ settlement behavior for this species? Could it be an artifact

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of the 'unnatural' settlement conditions?

L231-235 – since the results were not significant, there are no "distinct" differences. If the interaction is not significant, how can there be significant groupings stated on the figure (2c)?

L237 – "greatly alleviated" is an interpretation and does not belong in the Results section. The phrase "in contrast" is inappropriate here because settlement success was not statistically distinct with that under the fluctuating and constant regimes at 29degC.

L241 – what were the separate analyses?

L255 – replace "strongly" with "significantly." Also, the Chi-square test was not listed in the Results section. Please include.

L264-267 – again how can the authors claim this if the model was not statistically significant?

L270 – survival of what?

L275 – this is the first time Q10 is mentioned. This needs to be included in the methods and defined carefully for the broad readership. Why was Q10 calculated for these results and not the others?

Discussion

L279 –Based on my interpretation of the data, it was only lower at constant elevated temperatures.

L282 – "hardly impaired" – too qualitative

L283 – I am having difficulty with the phrase "greatly attenuated the thermal stress on settlement" throughout the manuscript (alleviated, mitigated, tempered...). Because of the lack of replication, it is hard to attribute the responses to thermal stress and constant vs. variable conditions. I think it would be better to say something like "did

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not produce the same negative response to high temperature as under exposure to constant high temperature." Based on the experimental design, it is impossible to know whether the corals simply experienced less thermal stress overall because they spent some time at temperatures less than 31degC each day or if they responded differently to the high temperature. These mechanistic possibilities should be discussed and phrasing should be more careful.

L288 – I don't think the authors can say that fluctuating conditions favor settlement because the 29degC constant and fluctuating conditions produced statistically similar settlement rates. Furthermore, when did settlement happen? Did it happen during the daytime when temperatures were higher, or during the nighttime when temperatures were lower? These details could be important for appropriate interpretation of the results.

L298-301 – what about the desperate larval hypothesis?

L327 – both constant and fluctuating T treatments

L340-342 – this sentence needs to be better integrated with the paragraph

L344 – this section does not mesh well with the rest of the Discussion

L407-410 – but calcification rates increased under the high temperature treatments. . .?

L429 – but it was still elevated compared to the 29degC treatments...

Figure S1. Panels a and b are not very relevant displays of temperature information for useful interpretation of the experimental design. A plot showing average seasonal daily temperature variability would be more useful. Plot d needs to have an x-axis label.

Technical comments

L116 – Doesn't the dataset go to 2016, not 2015?

L123 – Should Fig. S1d be cited here instead of S1c?

There are consistent errors in grammar and word choice throughout the manuscript. While it does not impede the reader from understanding the scientific content, I advise the authors to carefully copy edit the entire text.

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