

***Interactive comment on “Light effects on the isotopic fractionation of skeletal oxygen and carbon in the cultured zooxanthellate coral, *Acropora*: implications for coral-growth rates” by A. Juillet-Leclerc and S. Reynaud***

**Anonymous Referee #1**

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Review of ms. “Light effects on the isotopic fractionation of skeletal oxygen and carbon in the cultured zooxanthellae coral, *Acropora*: implication for coral-growth rates” ; Authors: A. Juillet-Leclerc and S. Reynaud.

In this ms. results on skeletal isotopic and metabolic measurements of the branching coral *Acropora* (tips from 24 branches were sampled from a single parent colony) cultured in constant temp. conditions and subjected to two light intensities, published earlier (Reynaud-Vaganay et al., P3, 175, 2001) are revisited. Previously it was assumed that the average geochemical response based on several colonies is more significant

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than data provided by single colonies. However, individual metabolic and isotopic responses between colonies can apparently differ significantly. Therefore, the existing data set (Reynaud-Vaganay et al., P3, 175, 2001) was reconsidered by inspecting individual coral responses and resolving a previously unnoticed effect of light on the  $\delta^{13}\text{C}$  signal of the carbonate. Authors observed that nubbins which show increase in  $\delta^{13}\text{C}$  are associated with high zooxanthellae productivity but have low surface extension, while those showing a decrease in  $\delta^{13}\text{C}$  are associated with limited productivity but exhibit higher surface extension. The authors conclude that extension and accretion are two separate growth modes with the former being light-repressed and accretion light-enhanced.

These findings are important since separating the effect of temperature and light on isotopic compositions and since confirming the differential isotopic behavior of calcification centers versus fibers. Overall it bears consequences for coral-based paleoclimate reconstruction.

Not being a specialist on corals my comments below pertain more to the re-interpreted results of the past experiment (Reynaud-Vaganay et al., 2001), rather than on the implications and consequences, which the authors detail at length in the discussion section.

General:

The effect of two light levels on metabolic rates (photosynthesis; respiration), coral growth (extension; accretion) and isotopic composition was studied in a constant temperature environment. But did authors also monitor evolution of pH (and alkalinity)? Is it possible that changes in pH had an effect on isotopic composition ? Please clarify, discuss.

While abstract and introduction and informative and well written, this is less so for several subsequent sections. In particular sections 3.2 (“Partitioning into two groups”) and 3.3 (“Duality of metabolic and isotopic responses at HL”) are difficult to read, as are

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the legends of the associated Figures 1 and 2. This partly is due to the fact that the authors combine the description of the opposing effects of LL vs HL conditions within single sentences; this together with poor figure quality makes life difficult for the reader! Authors should do a serious effort to improve on this.

Quality of figures is poor (symbols too small; awful colours, darker - clearer colours are barely distinguishable), making their understanding difficult (especially figures 1 to 4) and the discussion difficult to follow.

Specific comments are:

Section 2.3, p10249: the equation at line 23 represents a fraction (Pn/R) and not a rate; it should be called P/R ratio instead (see p10246, line 19), and so how was GPP rate then calculated (since  $GPP = NPP + R$ ) ? Pn and R are assumed to be rates per hour (specify this).

Section 2.4, p10250: This section should also detail how surface extension was assessed (now explained in section 2.3). Authors should clearly explain the differences between calcification rate, extension rate, accretion rate. The formula shown does not provide a rate in terms of weight/time but rather an increase of weight relative to an initial weight; this should be specified.

Section 2.5, p 10250: the delta notation at line 13 should read  $\delta d(\text{sample}) = [(R_{\text{sample}} / R_{\text{standard}}) - 1] \times 10^3$

Section 3.1, p10251: Line 23, the sentence "Despite their high variability, this observation strengthens the significance of the metabolic response of the colonies compared with a study considering only the averages across several nubbins" is unclear; averages of what ?

Section 3.2, p10252: The sentence starting line 1: "We divided the results from the nubbins into two groups: those showing a  $d^{13}C$  increase from LL to HL (the expected response according to the global carbon-pool assumption, Goreau, 1977) and those

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showing depletion (Erez, 1978) (Fig. 1c)" should be changed to: "We divided the results from the nubbins into two groups: those showing a  $d^{13}C$  increase from LL to HL (the expected response according to the global carbon-pool assumption, Goreau, 1977) and those showing a  $d^{13}C$  decrease at HL (i.e., the expected response in case of uptake of  $^{13}C$ -depleted metabolic carbon, Erez, 1978) (Fig. 1c)"

Same page, Lines 14-18: The sentences "Surface extensions of the nubbins showing lower  $d^{13}C$  (insert here: 'at high light') (Fig. 1a, dark bar) were almost all greater than that measured on the nubbins showing higher  $d^{13}C$  but always lower than at LL. For the two groups (Fig. 1a, clear and dark bars), the weight of colonies at least doubled during the incubation, while surface extension was reduced by ca. 40% (Fig. 1c)" are very confusing and need to be rephrased. Surface extension can not be reduced (would mean dissolution), but rather is less than the surface extension for a different experimental condition ..

Section 3.3, p10253: Line 10, what is the meaning of "(for the others)" ? Same page: Line 16-18: the sentence "Such a relationship cannot be related to the metabolic normalization taking into account the surface of newly formed skeleton; indeed, the units of productivity are  $\mu\text{mol O}_2\text{m}^{-2}\text{s}^{-1}$ " is unclear, please rephrase.

Section 4, Discussion, Line 16: "...was the opposite to that of the calcification rate" should this not read "...was the opposite to that of the accretion rate", since all nubbins doubled their initial weight, thus had similar calcification rates ?

Section 4.6, p10260:Line 13: in sentence starting "As shown in figure 5 there was a side where the newly deposited mineral corresponded essentially to accretion of fibers ..." which side is this A, B ? specify this please.

Section 4.7, p 10261: line 6: "We demonstrated that HL enhanced fiber formation" this was not demonstrated in the present study, but refers to Juillet-Leclerc et al., 2009 ? Please add reference here. Lines 9-10: easy understanding of this needs reference to Figure 1. Please help the reader where to look for the appropriate information in the

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figure !

Figures: quality of the figures should be improved by choosing appropriate symbols and colours. Especially the poor quality of the latter make the reading of the figures very difficult. Figure 1a: does not show clear (dark) bars as stated in the legend, but shows lines ..

Table 1: avoid use of colours in the table. Specify that Pnet and Resp are expressed in terms of O<sub>2</sub> production, consumption. What does sample 26bis mean ? Was this nubbin subsampled ? please clarify

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