

## ***Interactive comment on “Ocean acidification and nutrient limitation synergistically reduce growth and photosynthetic performances of a green tide alga *Ulva linza*” by Guang Gao et al.***

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This manuscript details the results of a classical pCO<sub>2</sub> x Nutrients experiment with seaweeds. In that respect its novelty relays in the distinction between N and P limitation, while most of the phenomena concerning pCO<sub>2</sub> x N has been described before in *Ulva* sp. (eg. Gordillo et al. 2001 *Planta* and Gordillo et al. 2003 *Planta*).

Response: We agree with these comments. Gordillo et al (2001, 2003) did excellent work on the interaction of CO<sub>2</sub> and N. Another novel point of our study is that we used diluted natural seawater as nutrient limiting condition rather than natural seawater to mimic the situation in seaweed cultivation areas.

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Main comments A major concern is about net photosynthesis. As it is measured (O<sub>2</sub> evolution), changes can derive either from photosynthesis or from respiration. Since respiration of seaweeds is commonly affected by pCO<sub>2</sub> (Iñiguez et al. 2015 *Polar Biol.*; Iñiguez et al. 2016 *Mar Biol*) even in *Ulva* (e.g. Gordillo et al. 2003 *Planta*) and also by nutrients, authors must show respiration rates along with the net or gross photosynthesis. Otherwise, not much can be said about the effect of pCO<sub>2</sub> and nutrients on photosynthetic O<sub>2</sub> evolution.

Response: We totally agree with these comments. We measured dark respiration rate, but did not represent it as neither pCO<sub>2</sub> nor nutrient affected it, indicating that changes of O<sub>2</sub> evolution derived from photosynthesis rather than respiration. The data of dark respiration have been added to the text. Please see lines 259-260.

Line 304. The ‘pigment economy’ phenomenon occurring in algae at high pCO<sub>2</sub> was first described in Gordillo et al. (1999 *J appl. Phycol*) and described for *Ulva* using exactly the same name by Gordillo et al. 2003 (*Planta*), so credit must be given to those authors.

Response: We agree with these comments and the text has been corrected to “This phenomenon of ‘pigment economy’ has also been found in the previous studies regarding *Ulva* species (Gordillo et al., 2003; Gao et al., 2016).” at lines 330-332.

Minor comments

Methods Incubation setup needs more detail. What type of recipient was used for adult thalli? At what density? Was the bubbling enough to make them move or were they settling on the bottom? Incubation light need more detail. What source of light was used (fluorescent tubes of daylight type?). Also how was the irradiance measured? (type of sensor, air or underwater?, lambda range?PAR?)

Response: We appreciate these comments. The thalli were grown in 1-L balloon flasks containing 900 mL of media with the density less than 0.1 g L<sup>-1</sup>. The cultures were bub-

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bled with ambient or CO<sub>2</sub>-enriched air at a rate of 300 mL min<sup>-1</sup> to make the thalli roll up and down. Daylight fluorescent tubes (21W, Philips) were used and light density was measured by a Quantum Scalar Laboratory (QSL) radiometer (QSL-2100, Biospherical Instruments, Inc., USA) that detects photosynthetically active radiation (400-700 nm). Please see section 2.1.

53. 'also' instead of 'only'

Response: Corrected.

148-150. Sentence is nonsensical, please rephrase.

Response: It has been corrected to "The measuring light was 0.01  $\mu\text{mol photons m}^{-2} \text{ s}^{-1}$  and actinic light was set as the same as the growth light (300  $\mu\text{mol photons m}^{-2} \text{ s}^{-1}$ )" at lines 167-169. 164. Units needed (nm)

Response: Corrected.

Tables 4 to 7 can be combined and look like table 2, so the information is not scattered.

Response: Tables 4 to 7 has been combined into a table, termed table 4.

Fig.2. The horizontal bar means significant differences between LC and HC, but that is hard to believe for some of the treatment at least like LNHP in (a), and HNHP and LNHP in (b). Please check your post-hoc comparisons. It is also highly convenient you mention the number of replicates (n) in the figure legends.

Response: The real indication of horizontal bars is that longer bars represent insignificant differences and shorter bars represent significant differences. We have realized that it is a little confusing. We have removed the longer horizontal bars to make it clear.

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