

Interactive comment on “Ideas and Perspectives: When ocean acidification experiments are not the same, reproducibility is not tested” by Phillip Williamson et al.

Phillip Williamson et al.

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We welcome both the overview summary and the three specific suggestions provided by Dupont. Specific responses follow for the latter.

COMMENT: I would tone down the first sentence of the Abstract. I do not think that Clark et al. is addressing such a general question. They were rather focusing on the work by Munday and colleagues.

RESPONSE: We recognise that the first sentence of the Abstract (“Can experimental studies on the impacts of ocean acidification be trusted?”) may seem over-general.

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That wording had an informal genesis, arising from conversational comments made at an international science-policy meeting in early 2020; it also reflected online articles that used Clark et al. (2020a) as the basis for wider criticism of ocean acidification research (e.g. Starck, 2020). Furthermore, such wording is consistent with the claim by Clark (2017) that “Too many researchers make up or massage their data... only stringent demands for proof can stop them”, without any indication that such criticism was specifically directed at Munday’s research team. Nevertheless, the above background was not included in the main text of our manuscript – and, since we do not consider it necessary to do so, we have responded to Dupont’s concerns by “toning down” the first sentence. Thus we now say “behavioural impacts”, rather than just “impacts”.

COMMENT: I would make the point that NO ocean acidification experiment can anyway simulate what is happening in the real world. So nobody is completely right or wrong if the experiment is well conducted (no fraud or big flaws) and honest with its limitations. You cannot design an experiment that will include the complexity of the real work and the time scale. This is another argument for a combination of experiments using different approaches (to answer different questions and then different part of the puzzle).

RESPONSE: We fully agree. We have therefore added the following text to our Introduction to make clear that ocean acidification experiments are necessarily simplifications of the real world, with the implications identified by Dupont;

“Laboratory experiments have investigated the biological impacts of ocean acidification through a reductionist approach; i.e. conditions are deliberately simplified. This approach has the advantage of enabling statistical testing of cause and effect for single factors, yet necessarily omits many of the complexities of natural conditions, that may involve temporal as well as biotic and abiotic environmental factors”.

COMMENT: The manuscript focusses on the Munday vs. Clark et al. recent disagreement. Maybe it would be beneficial to can also include another example. A similar

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discussion on the relevance of experimental studies occurred after the publication of the paper of Cornwall & Hurd (2015) highlighting the use of suboptimal experimental practices in many published articles in the field of ocean acidification. The article was covered by a short text in *Nature* entitled: 'Seawater studies come up short' (*Nature* 524, 18– 19; 2015) and followed by several media articles concluding that ocean acidification research was flawed. In a short response to *Nature* ("Laboratory seawater studies are justified", Hurd et al. 2015), we made similar points as this manuscript and highlighted the fact that laboratory studies are not ideal but one of the many tools (together with paleo studies, field work, models) that allow to capture the biological impact of ocean acidification.

RESPONSE: Dupont's reminder of previous discussions arising from Cornwall & Hurd (2015) is appreciated. This reference is now cited, in the context of recognising the need for appropriate rigour in the design and reporting of experimental studies. The issues raised in subsequent coverage by *Nature* were, however, somewhat different. Whilst Clark et al (2020a) considered that "small sample sizes and other methodological or analytical weaknesses" might account for minor impacts of ocean acidification previously reported, they dismissed that explanation for other studies showing large effects with large sample sizes. Instead, Clark (2017) and Clark et al. (2020a) emphasised the importance of video recording for their own studies, with implications of inadvertent bias or deliberate misconduct by others. When details of differences in experimental conditions were identified by Munday et al. (2020), there was only limited recognition by Clark et al. (2020b) that these differences could be relevant.

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