

Response to Reviewers – 2024-11-15

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Considerations for determining warm-water coral reef tipping points.

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Editor comments

I trust that your manuscript may be acceptable for publication in Earth System Dynamics following minor revisions according to the Reviewer's suggestions. I would also recommend adding a brief comment to the effect of the possible tipping points already having been crossed in the abstract and introductory sections. This is a natural question that many readers may have and that should be mentioned in the early part of the study, even though a more detailed discussion is deferred to the final section.

Author response: We have added a point about exceeding tipping points to both the abstract and introductory sections.

Reviewer comments

Review 5th November 2024 Lyndon DeVantier

LD: The authors have adequately addressed the points raised in my previous review. I have few remaining concerns, as here below.

Abstract and 2. Considerations for assessing coral reef TPs

Towards the end of these sections, consider including / expanding sentence(s),

a) noting that some predicted TPs have already been exceeded (albeit briefly), and that change is happening at rates faster than previously predicted, as outlined in section 14.

Author response: We have included a point about TPs being exceeded in both the abstract and section 2, and have added a point about the rate of change in the latter.

(b) the Abstract could also include the point that the multiple stressors are a powerful selective force – genetic bottleneck - driving significant population reductions and rapid acclimation of surviving corals (including shuffling of microbiome components) and via reproduction of survivors, the evolution of coral holobionts. The results of acclimation and adaptation will be population, species, habitat and region specific. Such evolution may, or may not, alter both the onset and rates of impact of TPs.

Author response: We attempted to include something on this in the abstract but were unable to fit something in without spoiling the flow of the current text and so have decided to omit this. We have ensured that this important point is covered in the section on resilience. For example we state “There is evidence of the persistence of heat adapted genotypes but the loss of poorly adapted corals leads to a loss of diversity”

5. Ocean acidification

Line 184: Typo... material due to decreases in saturation state of CaCO₃ ...

Author response: corrected

6. Deoxygenation

Line 230: Include sentence with more information and reference(s) to prior influence of deoxygenation in mass extinctions. Eg. *Intensified Ocean Deoxygenation During the end Devonian Mass Extinction* Jiangsi Liu, Genming Luo, Zunli Lu, Wanyi Lu, Wenkun Qie, Feifei Zhang, Xiangdong Wang, Shucheng Xie First published: 15 December 2019 <https://doi.org/10.1029/2019GC008614>

Author response: Line added to section.

Also consider noting the apparent irony that elevated SST and irradiance cause zooxanthellae to produce too much oxygen internally, causing toxicity to the coral host, while deoxygenation also linked with high SSTs causes deprivation.

Author response: This is an interesting point, but we feel it might confuse the message on deoxygenation. In the section where we introduce bleaching we mention the breakdown in the coral/zooxanthellae relationship which is directly related to the above point:
“Heat stress, in combination with irradiance, results from small increases in seawater temperature above the summer maxima to which corals are acclimatised, destabilising the symbiosis between host corals and their symbiotic algae, commonly referred to as coral bleaching (Hughes et al., 2017; Houk et al., 2020; UNEP 2020; IPCC 2022). “

9. Pollution & disruption

Line 308. Include sentence noting that overfishing is also linked with COTS outbreaks. See eg. *Babcock RC, Dambacher JM, Morello EB, Plagányi EE, Hayes KR, Sweatman HP, Pratchett MS. Assessing Different Causes of Crown-of-Thorns Starfish Outbreaks and Appropriate Responses for Management on the Great Barrier Reef. PLoS One. 2016 Dec 30;11(12):e0169048. doi: 10.1371/journal.pone.0169048. PMID: 28036360; PMCID: PMC5201292.*

Author response: A note to this effect has been added to the interactions section.

12. Reef impact example

Line 346: “... sponge *Cliona* spp (Sheppard et al., 2020) and almost no larvae were seen in these areas.”

LD: most coral larvae are not visible to the naked eye. Replace with ‘ ... no larvae were recorded’ or ‘no coral settlers were seen’, depending on the original paper’s findings and wording.

Author response: edited to “no coral settlers were seen”

Line 349: ‘...Both sedimented surfaces and turbid water are hostile to larval settlement and none were seen in such areas over many hectares’

LD: Rather than ‘hostile’ and ‘none were seen’, consider ‘not preferred conditions for larval settlement, with no juvenile corals recorded ...’ if this better matches the original paper’s findings.

Author response: edited as suggested

14. Resilience and adaptation

LD: consider renaming this section as 14. Resilience, adaptation and refugia

Author response: Renamed as suggested

Line 398: Need to complete sentence: "Kleypas et al., (2021) provide a blueprint for coral reef survival and state that existing conservation measures such as marine protected areas and fisheries management are no longer sufficient to sustain reef ecosystems and many additional and innovative actions to increase reef resilience are needed.

Author response: Sentence edited.