

## **Peer review:** Building heat-resilient Caribbean reefs: integrating thermal thresholds and coral colonies selection in restoration

### **General comments:**

Thank you for this intellectual contribution. This study investigates interspecific variation in bleaching for multiple species of Caribbean corals using three indices: Fv/Fm, pixel intensity, and visual scores of bleaching, and identifies critical thermal thresholds for each species. The authors then use this threshold to quantify intraspecific variation of thermal tolerance, identifying thermally-tolerant individual corals that would be well suited for bleaching.

I found this study to be quite strong. This manuscript has a clever study design, is well written and well structured, and author assertions are supported with abundant references. My main overarching feedback would be that the discussion could be restructured a bit for clarity. There are a lot of well supported assertions (and qualifying statements), but they could be ordered into a bit more of a logical flow (within the sections of the discussion you already have) to more clearly drive home your key findings. I've also provided a number of specific edits and suggestions below:

### **Specific comments and suggestions**

<b>Lines</b>	<b>Comment or suggested edit</b>
23-49	The abstract has a lot of good content but is pretty long and could be further streamlined. For example, lines 28-34 and 45-49 are somewhat duplicative
53	"Human pressure" is fairly vague – can you list one or two specific pressures that were among the first to drive reef degradation in the Caribbean?
53-55	I would add hurricane impacts to this list
63-66	You are correct that ecological complexity requires us to approach restoration planning with care and consideration. In addition, the fact that anthropogenic and climate threats are not going away, restoration also has to be designed to account for these persistent threats, which further highlights the need for careful restoration planning and additional research into best-practices to boost restoration efficacy. It would be beneficial to add a sentence discussing this second point
70-72	True generally, although there are caveats here, since 1) bleaching doesn't guarantee mortality, so survival could still be high on reefs that experience bleaching, depending on the species and DHW severity, and 2) some <a href="#">studies</a> have found a disconnect between bleaching responses and the ultimate performance (growth) of survivors over time
90-102	These are all good points – I would add that long-term monitoring of outplanted corals to validate their performance on the reef is also a key limitation currently
105-107	Could you combine the first two questions, or am I missing some important nuance between questions 1 and 2?  "How do bleaching thresholds differ between coral species across a variety of temperatures, as well as across a variety of methods for evaluating heat stress?"
109-111	Consider rewording to: "This second objective is critical for identifying intraspecific variation in bleaching responses using the interspecific temperature thresholds

<b>Lines</b>	<b>Comment or suggested edit</b>
	developed under our first objective. Taken together, this approach which will help us identify optimal colonies for restoration for each species.”
111-114	I agree that your study is well set up to address these two gaps (identify Caribbean-specific bleaching thresholds and identify intra-specific variation that could correspond to resistant genotypes). How does this study address the other gaps noted in lines 90-102, particularly around the comparability of results obtained through different temperature systems, laboratory conditions reflecting actual conditions, seasonality of analysis, optimal number of colonies, etc.? I think your experimental design <i>does</i> address these, it would just be worth mentioning these as gaps to be addressed at the very end of the intro
126-129	Life history strategies, rather than life strategies. For the non-Caribbean reader, it might be helpful to include a sentence describing the morphology of each coral, or somehow incorporating morphologies as descriptors in your list of species names (e.g., branching <i>Acropora cervicornis</i> )
132	Recommend starting a new paragraph here
133-135	What do you mean by 50% of the stress response? A stress response by 50% of the colonies being tested? Or colonies on average exhibited 50% of the maximum stress value?
136-137	If I’m understanding this correctly, this sentence could benefit from the following rewording: “In the second phase, multiple colonies of each species were exposed to their species-specific T50 to evaluate intraspecific variability and identify the most thermally-tolerant coral individuals.”
170-173	Any justification or rationale for this setup?
217-218	Why not the other two? Not enough colonies/samples?
230-251	Based on the way you assigned ranks of 1 through 4, you guarantee a larger range of values and more variability for pixel intensity compared to your other two metrics, because you are using quartiles (so there are guaranteed to be values from 1 to 4). For FvFm and visual bleaching scores, it is possible for all colonies to score the same value, which you can see happens a few times in Figure 2. Due to this difference in how you are scaling these metrics from 1 to 4, won’t pixel intensity have a greater impact on the final summed calculation than the other two metrics?
249-251	Why not just take the weighted average so that thermal tolerance always ranges from 1 to 4?
285-286	Suggest rewording: “When we further explored these differences between species for each temperature, we found significant differences for all tested temperatures...”
300-302	Consider rewording for clarity
328-340	Were the “performance category” clusters visually identified from the PCA and then significant differences tested with the PERMANOVA? Or were clusters identified with some other type of cluster analysis? Was not entirely clear to me...
357-358	Again, using weighted average instead of sum could help account for this
376-380	This is a great short summary of the novel additions this study offers. To my earlier comment about 111-114, paraphrasing some of this text at the end of the intro could be helpful
384-387	I would be specific here and say that <i>M. cavernosa</i> and <i>A. cervicornis</i> had the highest T50 and that <i>D. labyrinthiformis</i> had the lowest T50. It feels a little confusing and vague

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	to say “best performing” and “worst performing”, since your study was evaluating these corals based on multiple different indicators...
384-435	This is a very long paragraph, please consider breaking out into multiple. I’d also urge you to revisit and refine the overall logical flow of this paragraph, it currently feels a bit all over the place (lots of “on the other hand”)
411-413	But there are also studies pointing to higher bleaching susceptibility of Acropora in the Caribbean compared to massive counterparts... I can think of several studies that find that branching corals in the Caribbean are still more susceptible than massive ones (e.g., <a href="#">Cramer et al. 2021</a> , <a href="#">Palacio Castro et al. 2021</a> , <a href="#">Langdon et al. 2018</a> ,
424-425	“massive <i>Porites</i> became one of the most susceptible taxa with increasing bleaching” Can you clarify this statement? Susceptible to bleaching, or to mortality? With increasing bleaching, or increasing heat stress?
431-434	This is a good point and something to emphasize
467	Would suggest “universal” rather than “perfect”
508-509	As I alluded to in an earlier comment, it is important to highlight how this method of calculating your scoring criteria influences your overall result. Is there a way to either use quartiles for calculating all three criteria, or to avoid using quartiles across all criteria, for consistency?
529-533	This text might be better earlier in the manuscript when you introduce FvFm and visual scoring so the reader understands why you are measuring them
540-543	This seems like the most logical reason to me (for whatever that’s worth)
599-615	The ultimate “future research” question seems to be what will happen to these corals once they are outplanted? Will corals identified as thermally tolerant actually perform better in real world conditions over time compared to a control reef?
612-613	This is a good point that a population’s T50 will likely change over time. Might be worth making this point earlier in the discussion where appropriate
626	“...highlighting the importance of intraspecific variation for selecting colonies for restoration”
Figure 2	Suggest restructuring to be a 7 row 3 column matrix (similar to Figure 4), where A) is the first column, B) is the second, and C) is the third. That way the reader can easily look across columns for a given row to see how a given species performs in terms of FvFm, pixel intensity, and visual assessment of bleaching