Structural and mechanical properties of the threatened coral *Acropora cervicornis* : Effects of nursery platforms on mechanical strength

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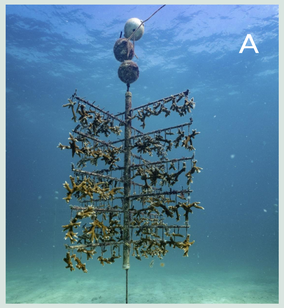
Introduction

- As natural coral populations decline, coral restoration efforts have become prevalent around the world
- Practitioners primarily use (A) mid-water floating “tree” and (B) bottom-attached “block” structures in coral nurseries



- Previous studies concluded block-reared corals have decreased total linear extension (TLE) but increased density compared to tree-reared corals[1]
- These structural differences may contribute to a mechanically weak colony which is of significant interest when restoring reefs in high energy environments
- We therefore mechanically tested corals raised on both nursery platforms to examine the differences in branch and whole-colony fragmentation to better support restoration efforts

Acknowledgements

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References

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2. Vosburgh F (1982) Acropora reticulata: Structure, Mechanics and Ecology of a Reef Coral. Proc R Soc B Biol Sci 214:481-499
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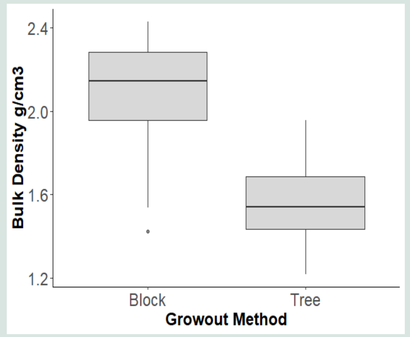
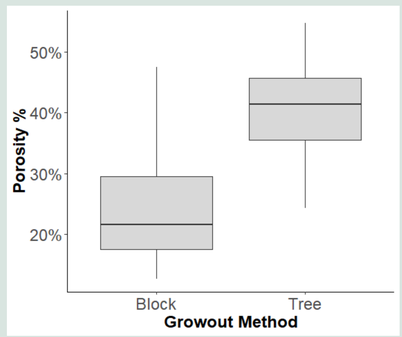
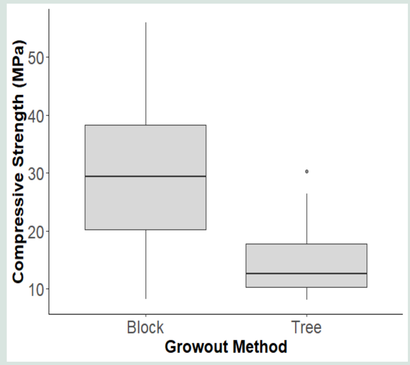
Results







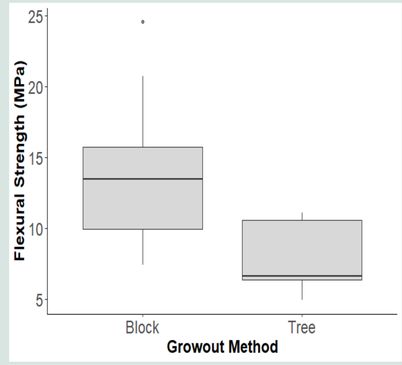


Fig. 1 Corals grown on blocks are on average 35% more dense and 42% less porous than tree-reared corals. Density two-sample t test: t = 13.535, p<.001; Porosity two-sample t test: t=11.179, p<.001;

Fig. 2 Block-reared corals had 99% greater compressive strength and 72% greater flexural strength than tree-reared corals. Compressive strength two-sample t test: t =3.4598, p<0.01; flexural strength two-sample t test: t=3.6006, p<0.01

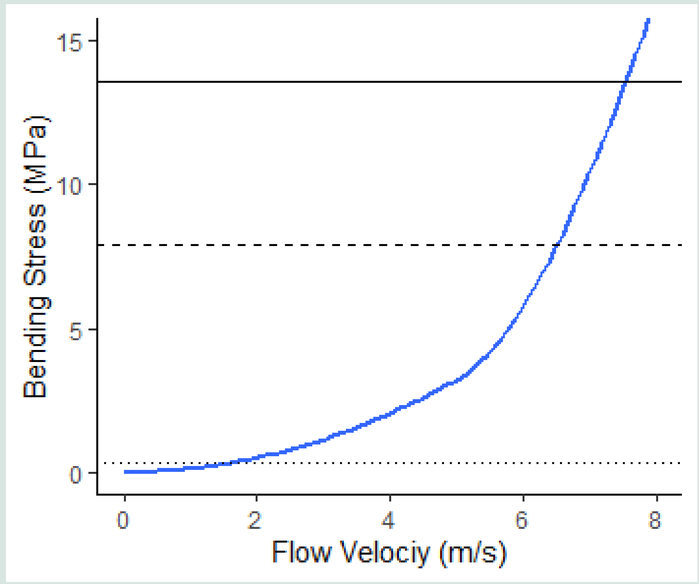
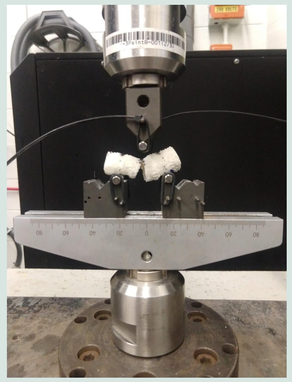


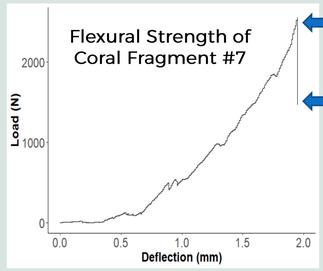
Fig. 3 Wave induced bending stress as a function of wave flow velocity. The mean average bending strength of block-reared (solid) and tree-reared (dashed) are greater than the expected stresses experienced in tropical storms (5m/s). The hardbottom substrate (dotted) fails at significantly less flow velocities as measured by Madin (2005) and this coral-substrate interface is expected to cause whole-colony dislodgement.

Methodology

Flexural testing



Staghorn corals are a branching coral and are dominated by hydrodynamic drag forces, therefore flexural (bending) tests are important to understand the mechanical stress on corals due to wave loading[2]



Conclusion

- Block-reared corals are significantly denser and less porous than tree-reared corals
- Block-reared corals have increased compressive and flexural strength compared to tree-reared corals
- Thus, block-reared corals will likely experience less branch fragmentation than tree-reared corals
- Whole-colony dislodgement is likely to occur before branch fragmentation[3], therefore increased strength of block-reared corals may not be realized, and rates of dislodgement are expected to be similar
- Restoration practitioners should prioritize increasing the bond strength of the colony-substrate interface and mitigate the threat of macroboring species, particularly on high energy reefs