Wave exposure shapes reef community composition and recovery trajectories at a remote coral atoll

Coral Reefs - Electronic Supplementary Material

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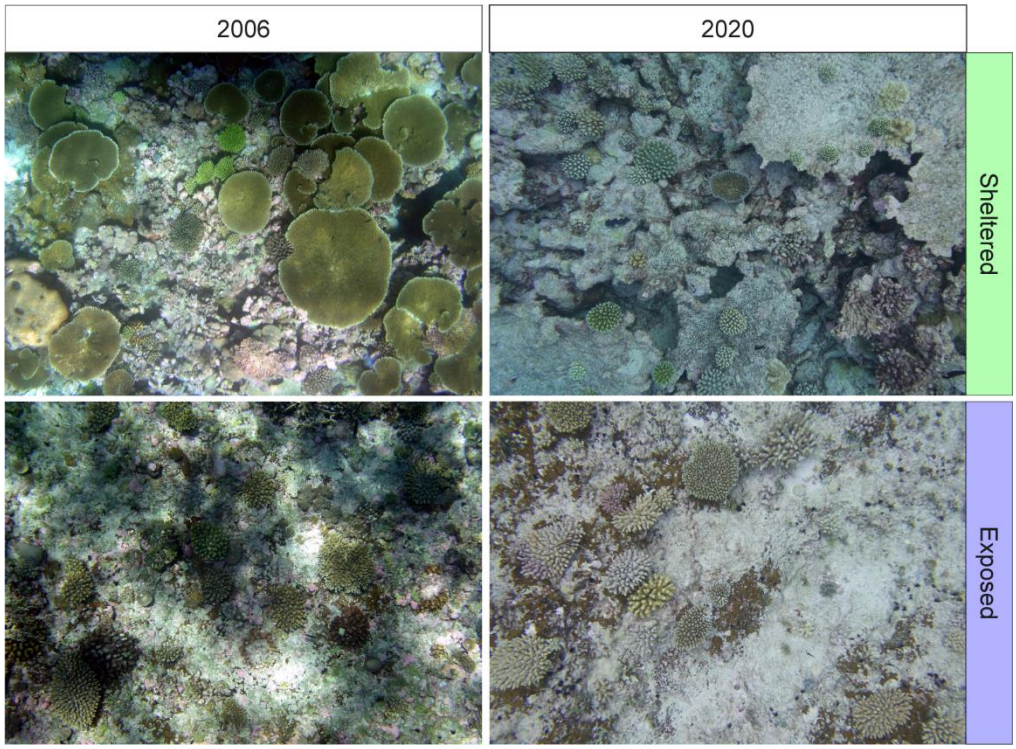
ESM 1: Locations of surveyed sites around Salomon atoll in 2006 (yellow; this study), 2010 (orange; Graham et al. 2013), 2016 (light purple; Head et al. 2019), 2018 (dark purple; Lange and Perry 2019) and 2019 (blue; Lange, unpublished data and Benkwitt and Graham, unpublished data). Satellite image: Google Earth V9.123.0.1. Salomon atoll 5°20’02’’S 72°14’25’’E, Camera altitude 23 km earth.google.com/web/ [18 December 2020]

References

Graham NA, Pratchett MS, McClanahan TR, Wilson SK (2013) The status of coral reef fish assemblages in the Chagos Archipelago, with implications for protected area management and climate change Coral reefs of the United Kingdom overseas territories. Springer, pp.253-270

Head CE, Bayley DT, Rowlands G, Roche RC, Tickler DM, Rogers AD, Koldewey H, Turner JR, Andradi-Brown DA (2019) Coral bleaching impacts from back-to-back 2015–2016 thermal anomalies in the remote central Indian Ocean. Coral Reefs 38:605-618

Lange ID, Perry CT (2019) Bleaching impacts on carbonate production in the Chagos Archipelago: influence of functional coral groups on carbonate budget trajectories Coral Reefs 38:619-624



ESM 2: Representative photographs of benthic communities on fore reefs around Salomon atoll in 2006 and 2020 at sheltered and exposed sites. Note that 2006 photographs were taken from slightly larger distances to the reef but in similar water depth (6-8 m).

ESM 3: Statistical analysis output tables for 2020 community analysis

PERMDISP cluster groups at SIMPROF p=0.001 – 2 groups (betadisper)
Response: Distances

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Groups	1	0.004712	0.0047119	1.4202	0.2467
Residuals	21	0.069672	0.0033177		

PERMANOVA (adonis)
Permutation: free
Number of permutations: 999

	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Exposure	1	0.44664	0.44664	18.949	0.47433	0.001 ***
Residuals	21	0.49497	0.02357		0.52567	
Total	22	0.94161			1.00000	

PERMDISP cluster groups at SIMPROF p=0.05 – 6 groups (betadisper)
Response: Distances

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Groups	5	0.016652	0.0033304	2.5419	0.06813
Residuals	17	0.022273	0.0013102		

PERMANOVA (adonis)
Permutation: free
Number of permutations: 999

	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
SIMPROF	5	0.73514	0.147028	12.106	0.78073	0.001 ***
Residuals	17	0.20647	0.012145		0.21927	
Total	22	0.94161			1.00000	

PCA	square root transformed cover data, Bray-Curtis similarity matrix	
	Inertia	Proportion
Total	13	1
Unconstrained	13	1

Eigenvalues, and their contribution to the correlations

Importance of components:

	PC1	PC2	PC3	PC4
Eigenvalue	5.4404	2.1087	1.3608	1.03926
Proportion Explained	0.4185	0.1622	0.1047	0.07994
Cumulative Proportion	0.4185	0.5807	0.6854	0.76532

Scaling 2 for species and site scores

* Species are scaled proportional to eigenvalues
* Sites are unscaled: weighted dispersion equal on all dimensions
* General scaling constant of scores: 4.112364

Species driving community composition differences (envfit)

	PC1	PC2	r2	Pr(>r)
Acropora branching	0.40190	0.91569	0.5394	0.003 **
Acropora table	-0.31830	0.94799	0.3035	0.026 *
All encrusting	-0.98099	0.19404	0.7720	0.001 ***
Other massive	-0.87447	0.48508	0.6268	0.001 ***
Porites massive	-0.94605	-0.32403	0.6102	0.001 ***
Soft corals	-0.93884	-0.34436	0.4932	0.002 **
Sponges	0.68825	0.72547	0.5418	0.001 ***
Sand	0.64479	-0.76436	0.4186	0.004 **
Dead *Acropora* table	-0.99807	-0.06203	0.5881	0.001 ***
Pavement	0.86051	-0.50943	0.8008	0.001 ***
Rubble	-0.99646	-0.08412	0.7722	0.001 ***
Other branching	0.31268	0.94986	0.1697	0.176
Macroalage	0.80453	0.59391	0.3651	0.011 *

Post-hoc addition of wave exposure in J m^{-3} (continuous variable) as explanatory variable (envfit)

	PC1	PC2	r2	Pr(>r)
Wave exposure	0.996500	0.083593	0.9207	0.001 ***

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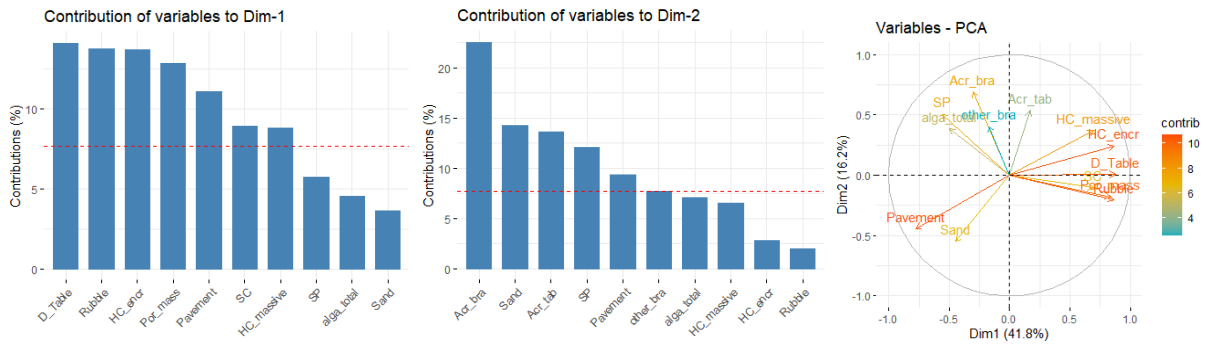

ESM 4: Contribution of species variables to grouping of community compositions at 23 fore reef sites around Salomon atoll

ESM 5: Statistical analysis output tables for 2006 and 2006-2020 analysis

PERMDISP 2006 comparing sheltered and exposed sites (betadisper)
Response: Distances

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Groups	1	0.00975	0.0097491	0.5897	0.4515
Residuals	20	0.33067	0.0165336		

PERMANOVA (adonis)
Permutation: free
Number of permutations: 999

	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Exposure	1	0.52602	0.52602	4.7929	0.19332	0.002 **
Residuals	20	2.19501	0.10975		0.80668	
Total	21	2.72104			1.00000	

PERMDISP sheltered sites comparing 2006 and 2020 (betadisper)
Response: Distances

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Groups	1	0.13792	0.13792	9.1764	0.006625 **
Residuals	20	0.30059	0.01503		

PERMANOVA (adonis)
Permutation: free
Number of permutations: 999

	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Year	1	0.65434	0.65434	7.8319	0.2814	0.001 ***
Residuals	20	1.67097	0.08355		0.7186	
Total	21	2.32531			1.00000	

PERMDISP exposed sites comparing 2006 and 2020 (betadisper)
Response: Distances

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Groups	1	0.11846	0.118455	24.414	6.89e-05 ***
Residuals	21	0.10189	0.004852		

PERMANOVA (adonis)
Permutation: free
Number of permutations: 999

	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Year	1	0.36591	0.36591	7.5407	0.26421	0.001 ***
Residuals	21	1.01901	0.04852		0.73579	
Total	22	1.38492			1.00000	