Electronic Supplementary Material

High-latitude mass coral bleaching in Sydney Harbour driven by the 2015–2016 heatwave

Samantha Goyen [1*], Emma Camp [1], Lisa Fujise [1], Alicia Lloyd [1], Matthew Nitschke [1,2], Todd LaJeunensse [3], Tim Kahlke [1], Peter J. Ralph [1], David J. Suggett [1]

[1] University of Technology Sydney, Climate Change Cluster, Broadway, Ultimo NSW 2007, Australia

[2] Centre for Environmental and Marine Studies, University of Aveiro, Aveiro, Portugal

[3] Department of Biology, The Pennsylvania State University, 208 Mueller Laboratory, University Park, PA 16802, USA.

Supplementary Table S1. Physio-chemical *in situ* parameters measured in February, April, June and August at Fairlight (FL) and Middle Head (MH) (bi-monthly average ± SEM) and tank conditions measured in December, January and February (pre-bleaching), June and August (recovery) (average of n = 4 tanks ± SEM). Total alkalinity and pH were used with temperature and salinity to calculate pCO_2 and aragonite saturation state. Light (µmol photons m^{-2} s^{-1}) was calculated based on the diffuse attenuation coefficient model at 7 m for Sydney Harbour data and is represented as an average of n=4 tanks ± SE for the tank experiment. Nutrient values are n=3 ± SD.

	Sydney Harbour								Tank Experiment				
	February		April *(During bleaching)*		June *(Recovery)*		August *(Recovery)*		December (T_0)	January (T_1)	February (T_2)	June *(Bleached)* (T_3)	August *(Recovery)* (T_4)
Physio-chemical variable	*FL*	*MH*	*FL*	*MH*	*FL*	*MH*	*FL*	*MH*					
pH (total scale)	7.91 ± 0.02	8.17 ± 0.008	7.96 ± 0.02	8.22 ± 0.01	7.96 ± 0.06	8.27 ± 0.006	8.11 ± 0.02	8.24 ± 0.01	7.92 ±0.09	7.76 ± 0.03	7.88 ± 0.06	7.97 ± 0.09	7.94 ± 0.04
Temperature (ºC)	25.9 ± 0.9	26.6 ± 0.2	23.1 ± 0.3	23.7 ± 0.7	18.4 ± 0.4	18.3 ± 0.07	17.2 ± 0.7	17.5 ± 0.1	20.5 ± 0.4	22.1 ± 0.3	25.9 ± 0.5	19.1 ± 0.1	17.8 ± 0.1
Aragonite saturation state	2.7 ± 0.2	2.6 ± 0.06	3.6 ± 0.1	2.9 ± 0.06	3.02 ± 0.2	2.1 ± 0.08	3.8 ± 0.08	3.8 ± 0.1	3.4 ± 0.1	3.3 ± 0.2	2.3 ± 0.07	2.09 ± 0.2	3.05 ± 0.09
pCO_2 (µatm)	226.7 ± 10.3	263.1 ± 5.9	214.3 ± 5.9	258.8 ± 9.5	202.7 ± 15.9	188.9 ± 7.9	241.1 ± 8.7	248.3 ± 10.6	244.4 ± 18.1	305.1 ± 11.1	227.3 ± 22.2	272.1 ± 26.0	238.4 ± 19.6
Total Alkalinity (µmol Kg/SW)	2193.3 ± 15.5	2208.3 ± 9.3	2383.9 ± 9.7	2370.5 ± 5.6	2019.8 ± 18.5	2025.8 ± 10.7	2442.1 ± 9.5	2456.3 ± 5.5	2209.3 ± 34.4	2082.3 ± 29.7	2176.9 ± 49.8	2172.3 ± 106.8	2336.2 ± 5.8
Salinity (ppm)	34.6 ± 0.3	34.1 ± 0.1	35.7 ± 0.1	35.4 ± 0.2	35.2 ± 0.7	33.6 ± 1.7	34.8 ± 0.08	34.2 ±0.4	35.2 ± 0.07	35.1 ± 0.08	34.7 ± 0.2	35.0 ± 0.06	34.7 ± 0.1
DO (mg/L)	7.82 ± 0.2	7.88 ± 0.05	8.31 ± 0.3	8.20 ± 0.05	9.04 ± 0.2	9.01 ± 0.03	9.39 ± 0.1	9.40 ± 0.04	8.25 ± 0.06	8.02 ± 0.3	8.61 ± 0.08	9.05 ± 0.8	9.58 ± 0.4

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Nitrate ($\mu g\ L^{-1}$)	156.9 ± 1.2	155.0 ± 2.0	137.9 ± 1.8	138.7 ± 0.3	105.5 ± 0.06	154.32 ± 5.3	114.1 ± 0.3	148.6 ± 0.3	148.0 ± 12.6	143.4 ± 10.2	153.1 ± 12.3	162.4 ± 6.1	76.8 ± 4.8
Nitrite ($\mu g\ L^{-1}$)	4.7 ± 0.7	5.7 ± 0.7	13.2 ± 0.4	11.0 ± 0.4	6.1 ± 0.9	5.78 ± 0.08	6.5 ± 0.2	7.0 ± 0.4	0.7 ± 0.3	6.9 ± 0.01	2.1 ± 0.1	1.06 ± 0.2	11.73 ± 0.2
Phosphate ($\mu g\ L^{-1}$)	3.1 ± 0.1	4.9 ± 0.1	7.9 ± 0.0	9.23 ± 0.06	2.5 ± 0.2	2.4 ± 0.1	8.3 ± 0.5	5.54 ± 0.8	27.4 ± 0.5	32.1 ± 0.38	45.8 ± 4.9	29.4 ± 0.9	20.1 ± 0.5
Ammonium ($\mu g\ L^{-1}$)	16.7 ± 0.3	17.5 ± 0.4	14.6 ± 0.03	37.0 ± 0.5	15.3 ± 1.2	9.91 ± 0.5	20.5 ± 0.1	18.5 ± 1.0	18.8 ± 9.1	14.4 ± 2.9	12.7 ± 3.8	9.3 ± 1.01	20.6 ± 1.5
Light (μmol photons $m^{-2}\ s^{-1}$)	253		195.63		120.5		152.94		307.3 ± 11.5	298.9 ± 10.7	308.1 ± 10.3	171.8 ± 10.5	184.1 ± 26.5

Supplementary Table S2. Raw data measurements for the experimental period (December-August) for the corals *P. versipora* and *C. mcneilli*. Measurements include net photosynthesis (P_G), respiration (R), calcification (G) and *Symbiodinium* density $\pm$ SE. ANOVA with Tukey's post-hoc and Kruskal-Wallis tests with pairwise comparisons and Bonferroni correction were used for statistical analysis across timepoints and species. (4) indicates significant difference from T_4, (3) indicates significant difference from T_3, * indicates significant difference from all ($p < 0.05$).

	Species	P_G	R	G_L	*Symbiodinium* density
		(μmol cm^{-2} h^{-1})			(cells/cm^{-2})
December (T$_0$)	*P. versipora*	1.77 $\pm$ 0.36	0.78 $\pm$ 0.09 (4)	0.52 $\pm$ 0.17	3.8 x 10^6 $\pm$ 0.9 x 10^5
	C. mcneilli	1.40 $\pm$ 0.15	0.64 $\pm$ 0.07	0.42 $\pm$ 0.10	3.7 x 10^6 $\pm$ 4.8 x 10^5
January (T$_1$)	*P. versipora*	1.72 $\pm$ 0.41	1.10 $\pm$ 0.15 (4)	0.23 $\pm$ 0.08	3.7 x 10^6 $\pm$ 4.8 x 10^5
	C. mcneilli	1.40 $\pm$ 0.15	0.64 $\pm$ 0.07	0.44 $\pm$ 0.10 (3)	3.6 x 10^6 $\pm$ 4.5 x 10^5
February (T$_2$)	*P. versipora*	1.67 $\pm$ 0.27	1.02 $\pm$ 0.17	0.45 $\pm$ 0.10	3.3 x 10^6 $\pm$ 1.7 x 10^5

	C. mcneilli	1.54 ± 0.21	0.68 ± 0.18	0.44 ± 0.12 (3)	3.7×10^6 $\pm 3.23 \times 10^5$
June (bleached) (T$_3$)	*P. versipora*	0.78 ± 0.09	0.70 ± 0.11	0.22 ± 0.13	0.5×10^6 $\pm 3.8 \times 10^4$ *
	C. mcneilli	2.03 ± 0.27 (4)	0.72 ± 0.10	0.03 ± 0.12 (1,2)	3.6×10^6 $\pm 4.6 \times 10^5$
August (recovery) (T$_4$)	*P. versipora*	0.80 ± 0.16	0.18 ± 0.04 (0,1)	0.10 ± 0.04	1.9×10^6 $\pm 0.9 \times 10^5$ *
	C. mcneilli	1.22 ± 0.13 (3)	0.25 ± 0.10	0.12 ± 0.05	3.7×10^6 $\pm 3.9 \times 10^5$
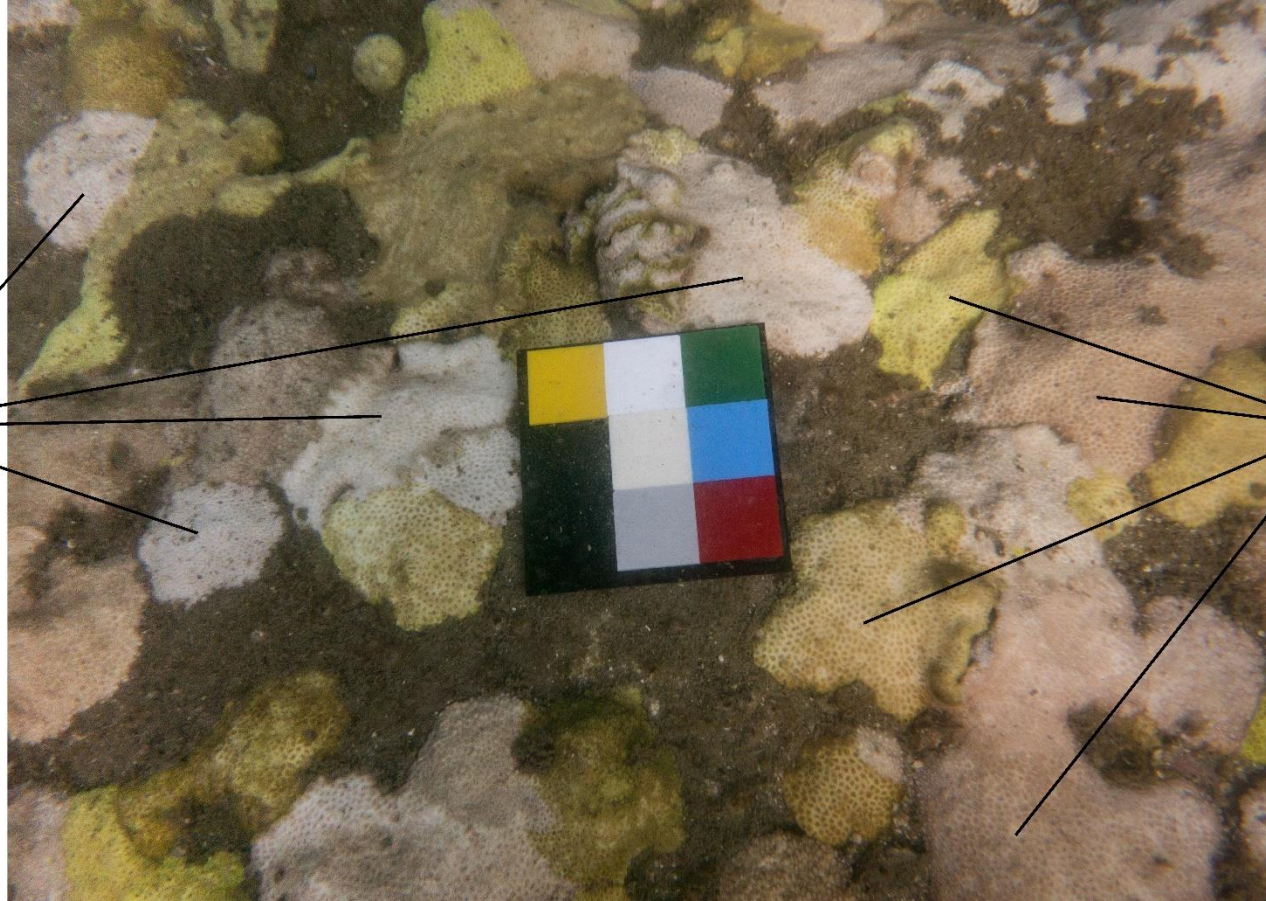
Bleached
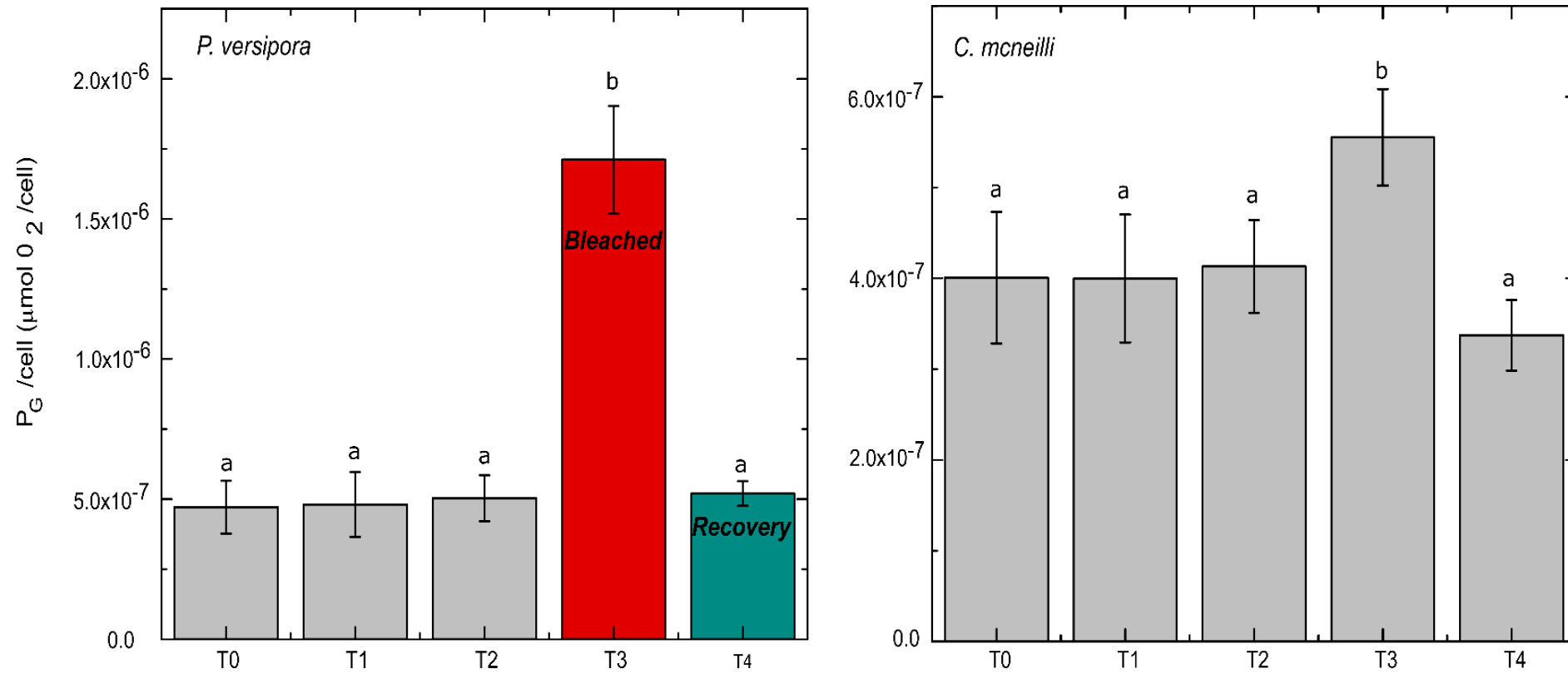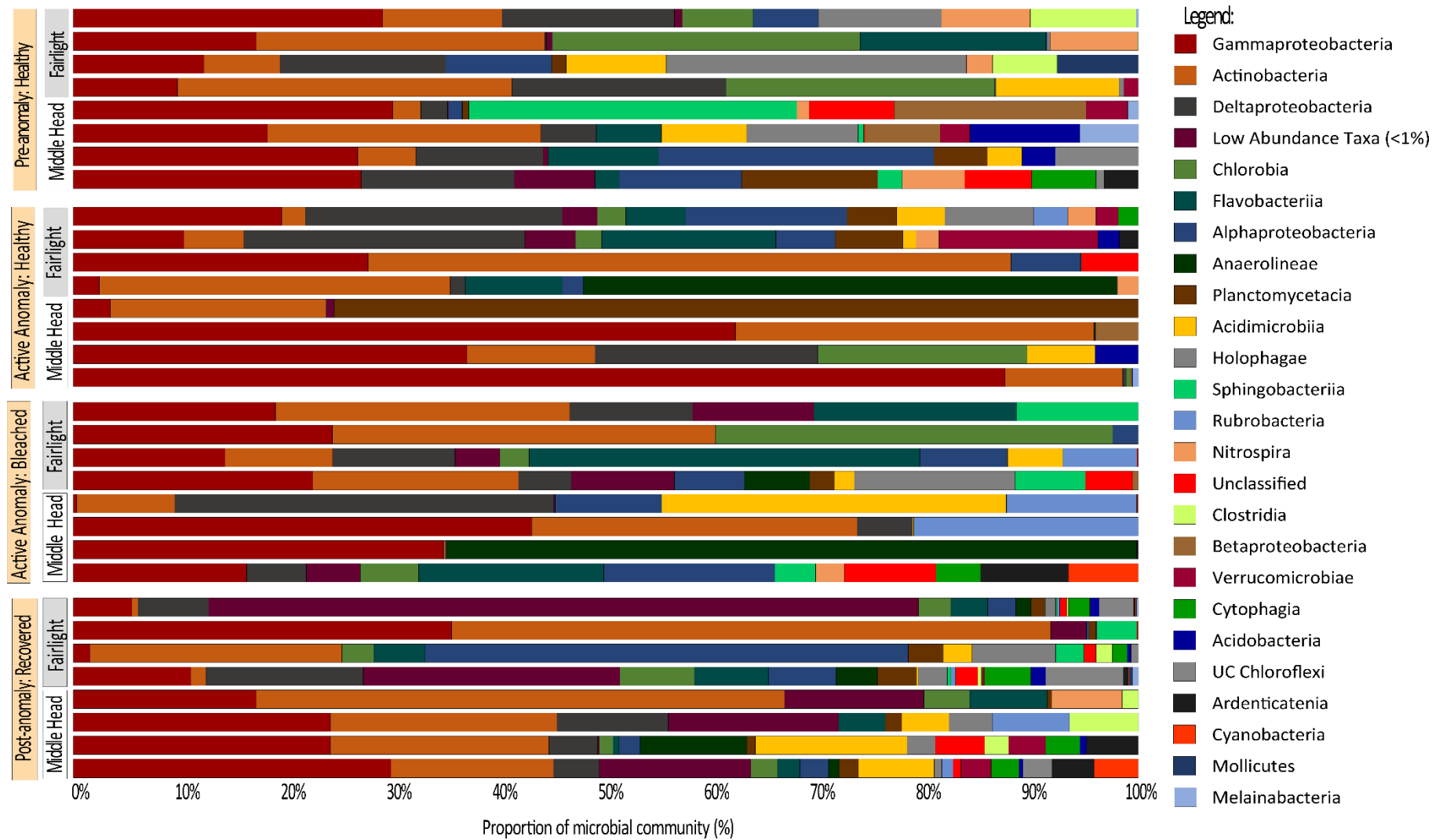
Pale (Bleaching)

Supplementary Figure S1: Annotated photo of bleached and pale *P. versipora* colonies from Fairlight.
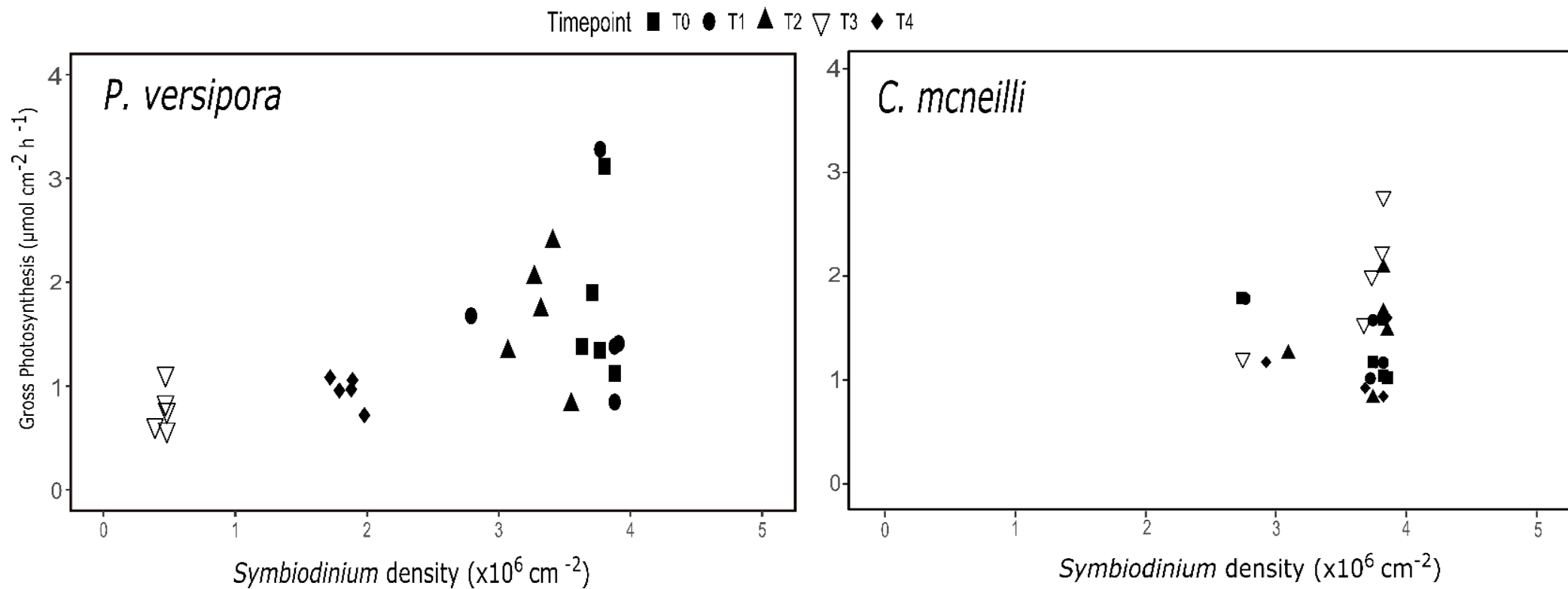
Supplementary Figure S2: Relationship between gross photosynthesis and *Symbiodinium* density over the experimental period (December T_0- August T_4) for *P. versipora* (left panel) and *C. mcneilli* (right panel).

Supplementary Figure S3: Gross photosynthesis per symbiont cell density over the experimental period (December T_0- August T_4) for *P. versipora* (left panel) and *C. mcneilli* (right panel).

Legend:
- Gammaproteobacteria
- Actinobacteria
- Deltaproteobacteria
- Low Abundance Taxa (<1%)
- Chlorobia
- Flavobacteriia
- Alphaproteobacteria
- Anaerolineae
- Planctomycetacia
- Acidimicrobiia
- Holophagae
- Sphingobacteriia
- Rubrobacteria
- Nitrospira
- Unclassified
- Clostridia
- Betaproteobacteria
- Verrucomicrobiae
- Cytophagia
- Acidobacteria
- UC Chloroflexi
- Ardenticatenia
- Cyanobacteria
- Mollicutes
- Melainabacteria

Supplementary Figure S4. Bacterial community composition (relative abundance %) of *P. versipora* for pre-anomaly (healthy), active anomaly healthy, active anomaly bleached and post-anomaly (recovered). Data is shown at the class level where possible. Shown taxon have a relative abundance >5%. The low abundance category contains the sum of all genera that made up <5% of the community. UC: Unclassified.
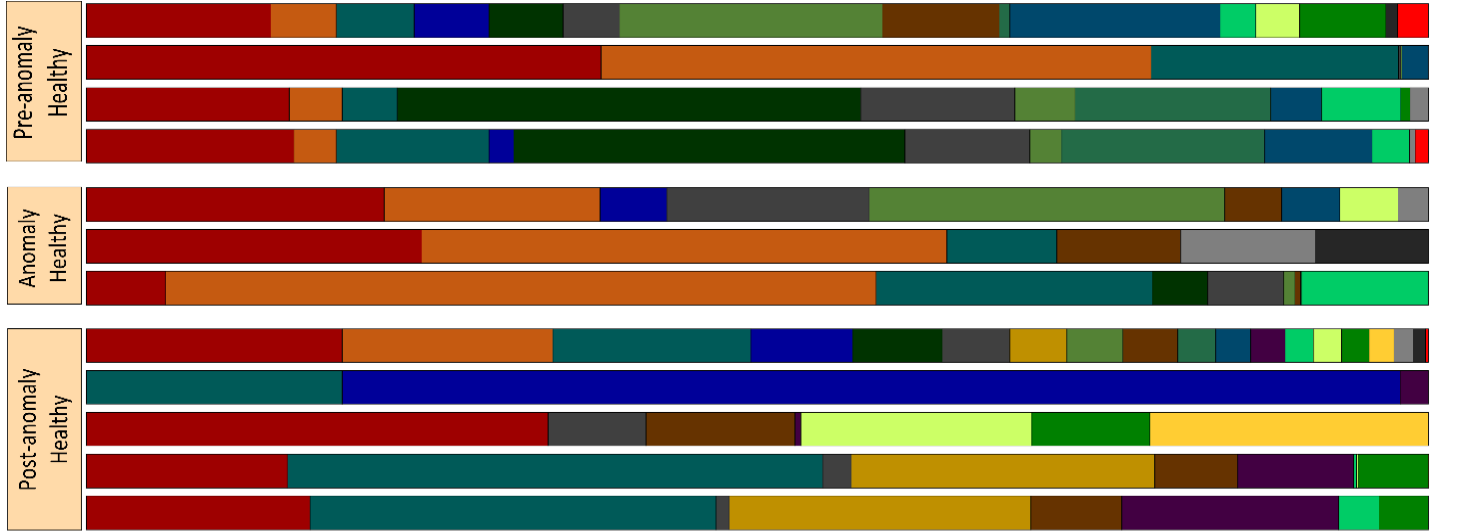
Legend:

Gammaproteobacteria | Actinobacteria | Flavobacteriia | Acidobacteria | Anaerolineae | Deltaproteobacteria | Bacteroidia | Chlorobia | Planctomycetacia | Spirochaetes | Alphaproteobacteria | Low abundance taxa | Sphingobacteriia | Clostridia | Cytophagia | Fusobacteriia | Holophagae | Ardenticatenia | Caldilineae | Cyanobacteria

Supplementary Figure S5. Bacterial community composition (relative abundance %) of *C. mcneilli* for pre-anomaly (healthy), active anomaly healthy, active anomaly bleached and post-anomaly (recovered). Data is shown at the class level where possible. Shown taxon have a relative abundance >5%. The low abundance category contains the sum of all genera that made up <5% of the community. UC: Unclassified.
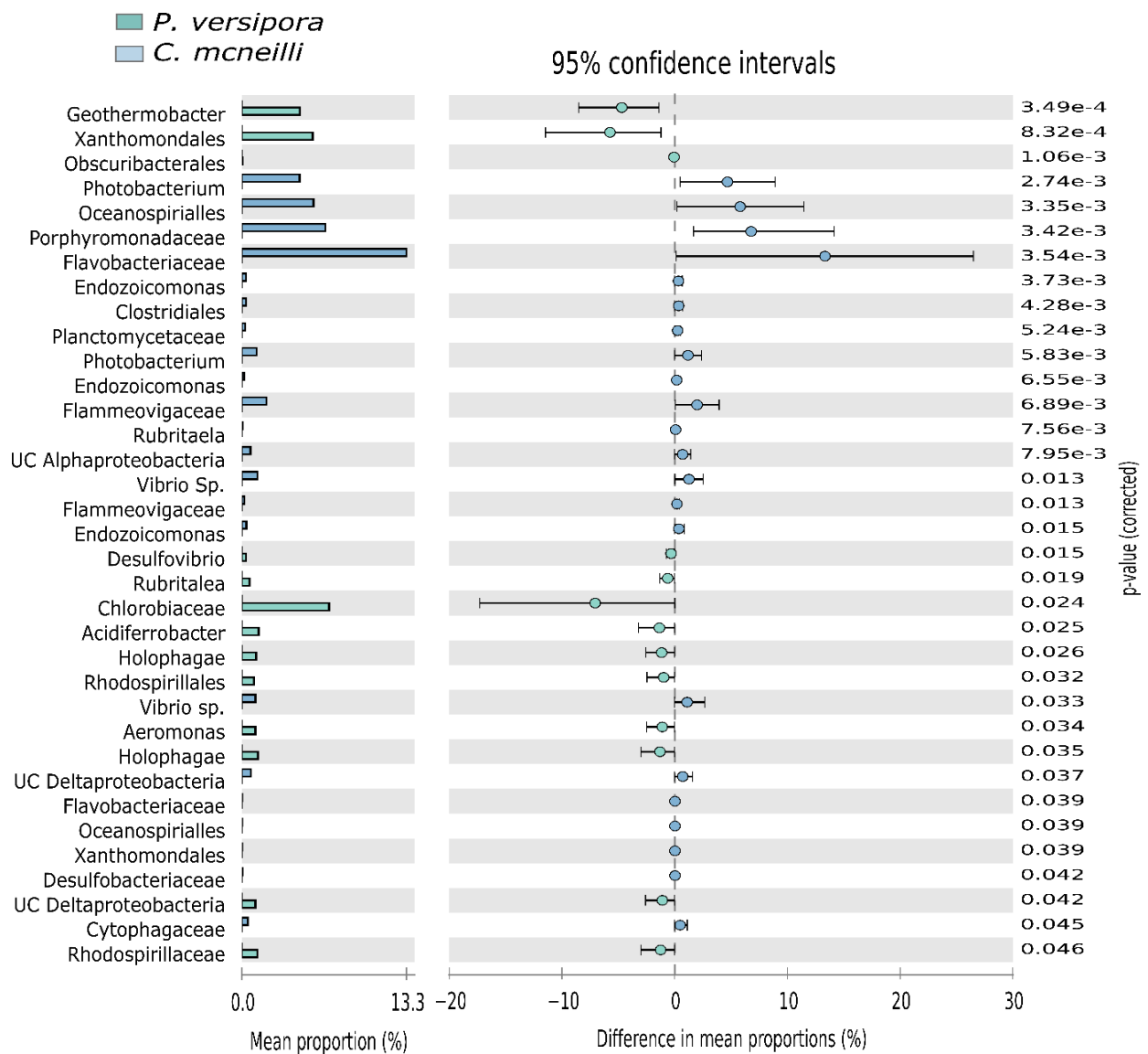
Supplementary Figure S6: February (pre-bleaching) dominant OTU mean proportion comparison for *P. versipora* (green) and *C. mcneilli* (purple). PERMANOVA; *p* = 0.014, t= 1.33 (significantly different).
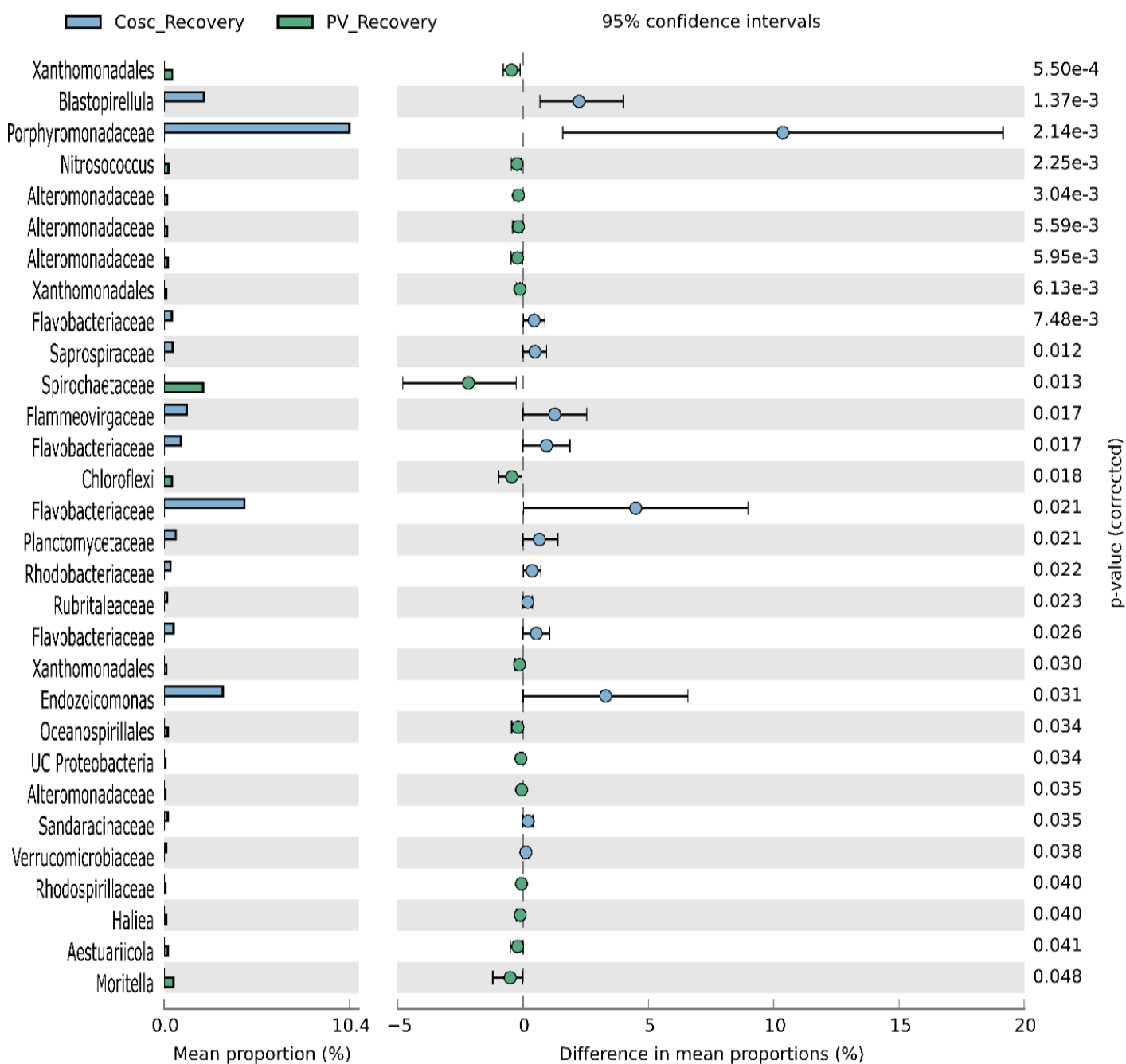
Supplementary Figure S7: August (recovery) dominant OTU mean proportion comparison for *P. versipora* (green) and *C. mcneilli* (purple). PERMANOVA; *p* = 0.004, t = 1.584 (significantly different).