Supporting Information

Materials and Methods – physiology measurements

The sections below provide additional procedural and analytical details for each of the physiological parameters measured in this study.

PAM fluorometry

Fv/Fm measurements were taken weekly at least 2 hours after sunset to ensure relaxation of photo-protective processes and PSII reaction centers. Each fragment was marked at the beginning of the experiment and all PAM measurements were obtained from the same location through time. For both species, the instrument was calibrated to produce F_o measurements of 300-500 units to avoid actinic effects. We used a saturation intensity of 8, saturation pulse width of 0.8s, and gain and damping were kept at 1 to minimize noise. Measuring light intensity was adjusted to 9 for *Pocillopora* and 4 for *Porites* due to the baseline differences in endosymbiont densities. The fiber-optic probe was positioned 5 mm above the coral surface for all measurements.

Respirometry

Each fragment was placed into separate polyacrylamide respirometry chamber with constant mixing at ambient water temperature and allowed to acclimate for 30 min. Each chamber (n= 12 total for 11 incubations and one blank per treatment level) was equipped with PreSens O2 Sensor Spots and illuminated with LED lights providing saturating irradiance (600 $\mu E\ m^{-2}\ s^{-1}$). Changes in oxygen concentrations were measured every 3 minutes for a 30-minute period, with 15 minutes in saturating irradiance, and 15 minutes in the dark (4 O_2 measurements per light and

dark period). Recordings were made at a single chamber for 5 seconds with 4-second rest between chambers at a sampling interval of 0.5 s, switching among chambers for the 30-minute duration of the observation. Oxygen production rate was determined from the change in oxygen concentration multiplied by the volume of water in the chamber (after coral displacement) and corrected for background photosynthetic activity or microbial respiration by subtracting rates measured in a blank chamber for each trial (one per treatment level per species). Adjusted rates were standardized to coral surface area.

Protein

Coral and endosymbiont proteins were solubilized through the addition of 1M NaOH, heated to 90°C for one hour and neutralized the pH to ~ 7.5 with 1 N HCl. Protein content was measured in triplicate at $\lambda = 562$nm against a bovine serum albumin standard curve and standardized to coral surface area.

Flow cytometry

We established the precision and accuracy of our cell density estimates by constructing species-specific linear relationships between flow cytometer counts and manual hemacytometer counts with slopes not significantly different from unity for either species (Fig. S4). Cell densities from hemacytometer counts were made from 6 replicate counts of 16-19 samples randomly taken from each species across the treatment levels.

Table S1. Mean Nitrate and Phosphate levels in each treatment. Standard error is reported in (). Each replicate aquaria was sampled weekly for the first four weeks of the experiment (n=12). Abbreviations for treatment levels used in subsequent tables are N0 = 0.01, N1=1.0, N2=3.0, N3 = 5.0, and N4 = 7.0 µmol Nitrate.

Targeted Nutrient Concentration	Nitrate + Nitrite (µmol L^{-1})	Phosphate (µmol L^{-1})
0.1	0.14 (0.05)	0.06 (0.01)
1	1.08 (0.18)	0.56 (0.03)
3	2.73 (0.32)	1.14 (0.10)
5	4.24 (0.34)	1.54 (0.12)
7	6.84 (0.43)	2.24 (0.15)

Table S2. Statistical summary for the fixed effects of linear mixed effects models. Results are presented for each species individually and significant response variables are indicated in bold. Significant differences in pairwise contrasts of treatment levels are indicated with |. Differences between tissue types are indicated directionally with >.

Species	Variable	Factor	SS	df	F	P	Pairwise Contrasts
Pocillopora acuta	**Calcification - Surface area**	Nutrient Level	0.80	4	8.4	**<0.0001**	N1 | N0, N2, N3, N4
		Error	2.07	84.86			
	Calcification - Protein	Nutrient Level	0.40	4	5.82	**0.0003**	N1 | N0, N3, N4
		Error	1.50	85.06			
	Total Protein - Surface area	Nutrient Level	0.39	4	1.23	0.3058	
		Error	7.32	91.12			
	Endosymbiont density - Surface area	Nutrient Level	16.34	4	21.12	**<0.0001**	N0, | N2, N3, N4; N1 | N2, N3, N4; N2 | N4
		Error	17.17	85.32			
	Endosymbiont density - Protein	Nutrient Level	5.99	4	12.40	**<0.0001**	N0, | N2, N3, N4; N1 | N2, N3, N4
		Error	10.35	84.70			
	Total Chl - Surface area	Nutrient Level	16.37	4	22.08	**<0.0001**	N0 | N1, N2, N3, N4; N1 | N4; N2 | N4
		Error	17.33	88.56			
	Total Chl - Protein	Nutrient Level	14.46	4	16.53	**<0.0001**	N0 | N1, N2, N3, N4; N1 | N4
		Error	18.75	84.58			
	Total Chl - Symbiont	Nutrient Level	2.51	4	4.15	**0.0041**	N0 | N1, N2, N3, N4
		Error	12.99	84.74			
	Maximum Quantum Yield	Nutrient Level	0.02	4	16.03	**<0.0001**	N0 | N1, N2, N3, N4; N1 | N3
		Error	0.03	87.36			
	Gross Photosynthesis	Nutrient Level	5514.3	2	3.45	**0.0567**	N0 | N4
		Error	12778.69	16			
	Net Photosynthesis	Nutrient Level	4528.8	2	5.40	**0.0256**	N0 | N4
		Error	6576.38	10.05			
	Respiration	Nutrient Level	55.93	2	0.24	0.7782	
		Error	1852.42	16			
	P:R	Nutrient Level	382.75	2	0.97	0.4091	
		Error	2874.52	11.18			
	$\delta^{13}C$	**Nutrient Level**	11.24	2	35.84	**<0.0001**	N0 | N2, N4
		Tissue	2.62	1	17.73	**0.0001**	Coral > Endosymbiont
		Nutrient Level * Tissue	0.47	2	1.48	0.2352	
		Error	9.31	58.20			
	$\delta^{15}N$	**Nutrient Level**	13.49	2	33.42	**<0.001**	
		Tissue	72.71	1	360.44	**<0.001**	
		Nutrient Level * Tissue	5.02	2	12.45	**<0.001**	
		Error	10.92	52.24			
	C:N	**Nutrient Level**	19.74	2	35.65	**<0.001**	
		Tissue	0.45	1	1.62	0.2	
		Nutrient Level * Tissue	5.20	2	9.38	**<0.001**	
		Error	18.25	65			

Table S2. Continued – *Porites compressa*

Species	Variable	Factor	SS	df	F	P	Pairwise Contrasts
Porites compressa	**Calcification - Surface area**	Nutrient Level	1.01	4	6.65	**0.0001**	N0 | N2, N3, N4; N1 | N2, N3
		Error	3.31	85			
	Calcification - Protein	Nutrient Level	0.96	4	7.14	**<0.0001**	N0 | N2, N3, N4
		Error	2.90	86.2			
	Total Protein - Surface area	Nutrient Level	0.32	4	0.66	0.6212	
		Error	11.14	85.92			
	Endosymbiont density - Surface area	Nutrient Level	2.27	4	4.49	**0.0025**	N0, N3 | N4
		Error	10.76	84.13			
	Endosymbiont density - Protein	Nutrient Level	1.25	4	2.76	**0.0331**	N0 | N4
		Error	9.61	84.26			
	Total Chl - Surface area	Nutrient Level	5.17	4	10.66	**<0.0001**	N0 | N1, N2, N3, N4
		Error	10.33	83.45			
	Total Chl - Protein	Nutrient Level	3.99	4	5.97	**0.0003**	N0 | N1, N2, N3, N4
		Error	14.09	83.30			
	Total Chl - Symbiont	Nutrient Level	2.32	4	5.47	**0.0006**	N0 | N1, N2, N3, N4
		Error	8.85	81.38			
	Maximum Quantum Yield (Fv/Fm)	Nutrient Level	0.01	4	15.04	**<0.0001**	N0 | N1 ,N2, N3, N4
		Error	0.02	86.432			
	Gross Photosynthesis	Nutrient Level	6376.2	2	0.9789	0.3968	
		Error	54951.06	16.28			
	Net Photosynthesis	Nutrient Level	2723.2	2	0.83	0.4555	
		Error	27731.12	16.26			
	Respiration	Nutrient Level	775.65	2	1.16	0.03369	
		Error	5763.46	16.41			
	P:R	Nutrient Level	105.14	2	0.78	0.4801	
		Error	1159.24	12			
	$\delta^{13}C$	**Nutrient Level**	5.82	2	14.40	**<0.0001**	N0 | N4
		Tissue	7.34	1	36.30	**<0.0001**	Coral > Endosymbiont
		Nutrient Level * Tissue	0.029	2	0.07	0.9307	
		Error	12.18	60			
	$\delta^{15}N$	Nutrient Level	1.68	2	2.21	0.1193	
		Tissue	23.18	1	60.87	**<0.0001**	Coral > Endosymbiont
		Nutrient Level * Tissue	0.28	2	0.37	0.6910	
		Error	22.89	58.20			
	C:N	**Nutrient Level**	4.09	2	21.07	**<0.0001**	
		Tissue	32.32	1	333.43	**<0.0001**	
		Nutrient Level * Tissue	0.70	2	3.61	**0.0331**	
		Error	5.92	58.88			

Table S3. Proportion of residual variance explained by colony for key physiological response variables. S and P denote standardized by surface area and total protein content, respectively.

Species	Response variable	Standardized by	Proportion of residual variance explained
P. compressa	Growth	S	27.05
		P	31.31
	Protein	S	2.23
	Endosymbionts	S	19.82
		P	15.97
	Chl-a	S	11.58
		P	15.67
	Chl-a per endosymbiont		9.49
P. acuta	Growth	S	14.96
		P	15.77
	Protein	S	0
	Endosymbionts	S	18.18
		P	17.71
	Chl-a	S	2.80
		P	13.45
	Chl-a per endosymbiont		13.56

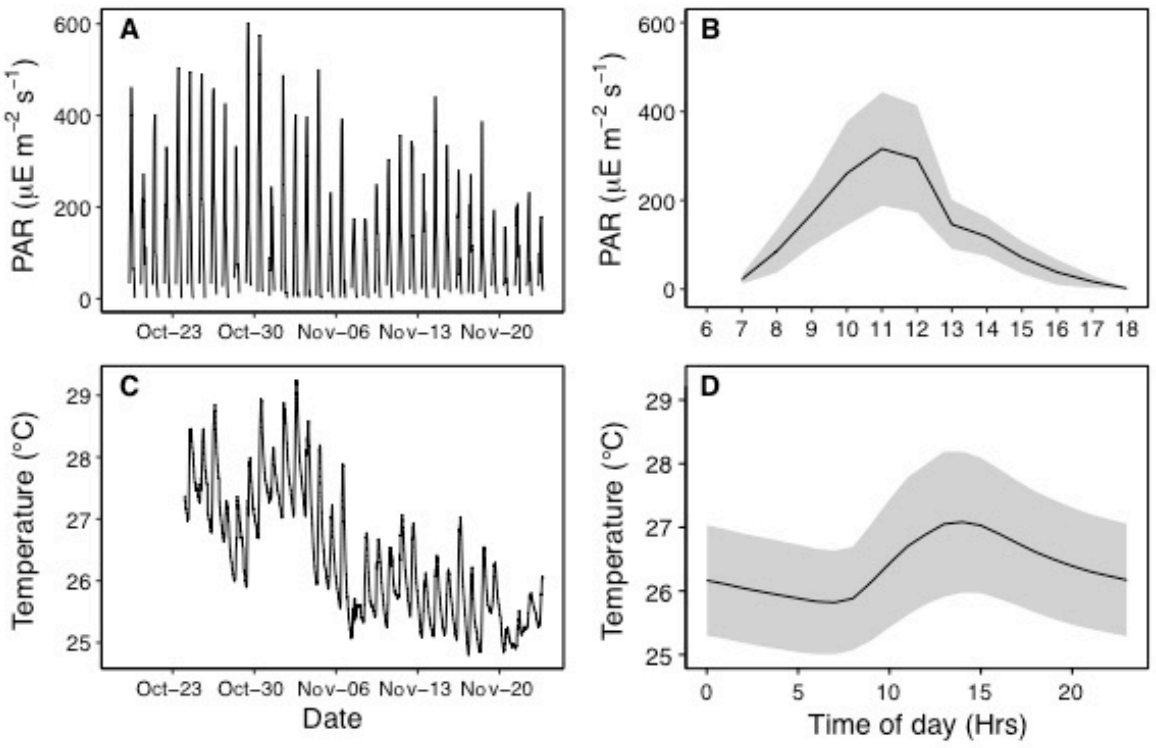
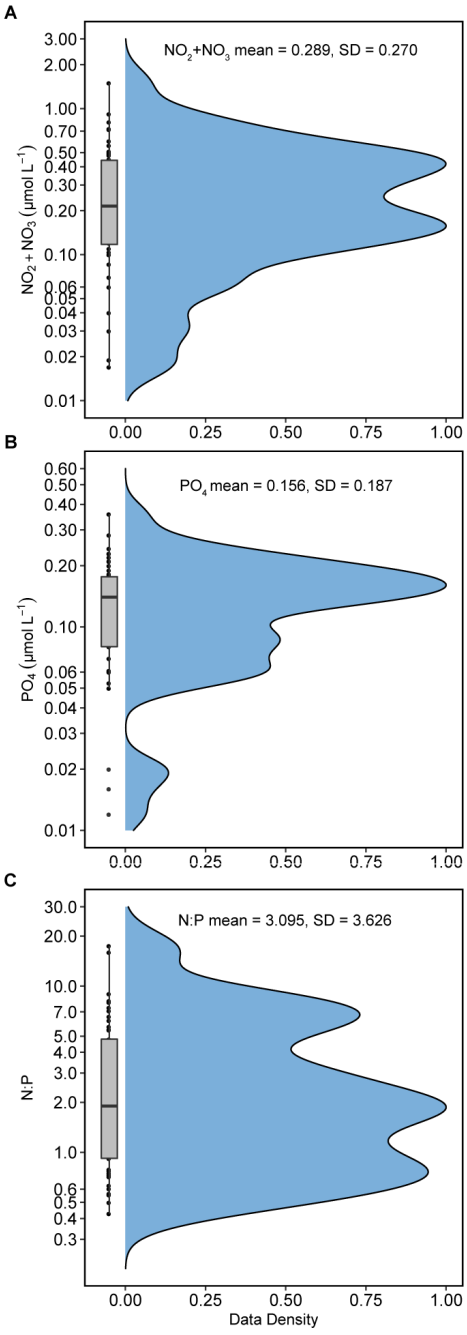


Figure S1 – Environmental conditions throughout the experiment. A) Ambient light levels measured at the center of the large incubation tank monitored using a LiCor 192SA (5 second sampling interval averaged every 5 min) affixed to the center of the incubation tank. B) The mean daily irradiance cycle based on hourly means between 0600 and 1800. The shaded region indicates standard deviation across all full days in the experiment. C) Daily temperature in the incubation tank monitored using a Hobo Pendant logger at 15 min intervals. D) Mean daily temperature fluctuations across 24 hours. The shaded region represents the standard deviation across all full days in the experiment.



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121 **Figure S2 – Baseline inorganic nutrient conditions in Kāne‘ohe Bay.** A) Dissolved inorganic
122 nitrogen (NO_2+NO_3), B) Phosphate, and C) Nitrogen: Phosphorous ratio. Boxplots are shown to
123 highlight median and interquartile range of discrete measurements taken between 2005 and 2008.
124 All measurements are shown as black points and the blue curve reflects the density of
125 measurements across the range of concentrations. All data are re-plotted from Table 1 in Drupp
126 et al. 2011 *Aquatic Geochem* DIO: 10.1007/s10498-010-9115-y.

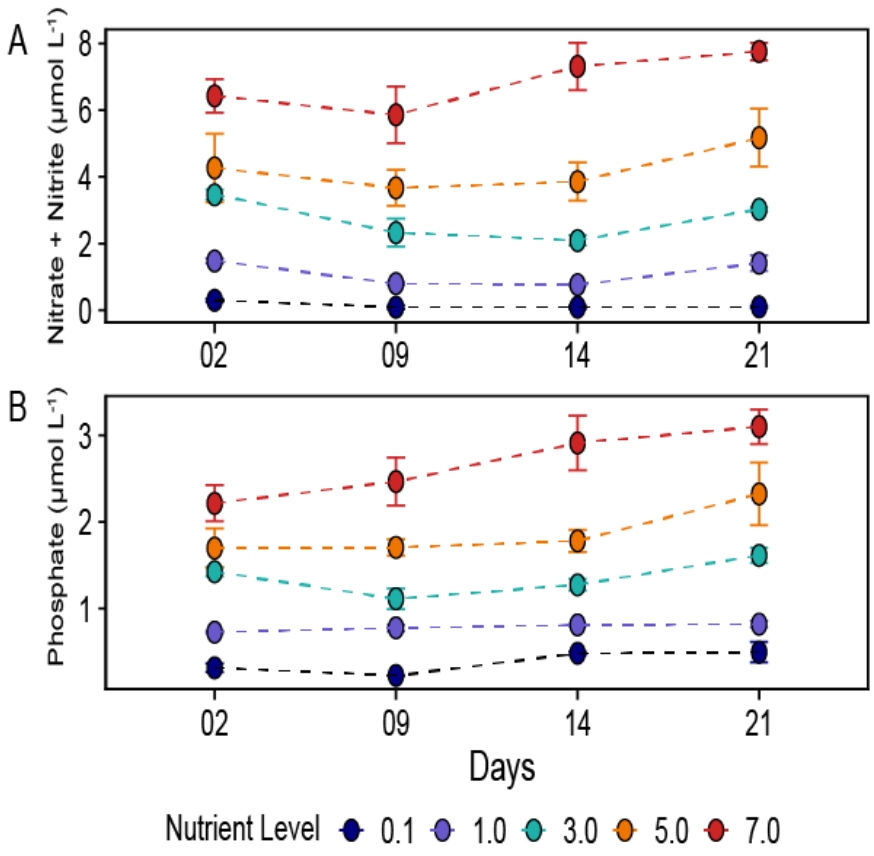
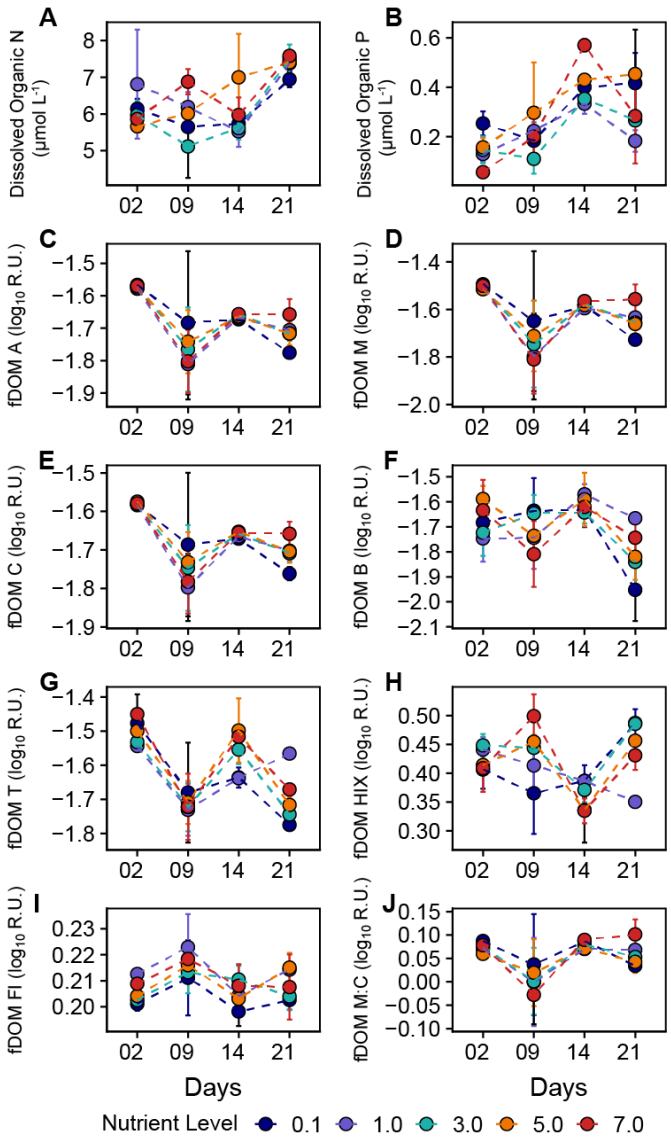


Figure S3 – Mean inorganic nutrient concentrations for each treatment level over the first three weeks of the experiment. A) Nitrate + nitrite and B) Phosphate. Values represent the mean of all samples collected from each treatment level throughout the experiment (n=12). Error bars represent standard error of the mean. Samples were frozen at -20°C until analysis and processed on a Seal Analytical AA3 segmented flow injection autoanalyzer at the University of Hawai'i SOEST Lab for Analytical Chemistry. Analytes included nitrate + nitrite and orthophosphate as well as total N and P using the same detectors, respectively, but with an in-line ultraviolet persulfate oxidation. We used a linear mixed effects model with replicate tanks included as an orthogonal random factor to test the effect of treatment and an interaction with time on nutrient concentrations in the aquaria.



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151 **Figure S4 – Stability of tank organic matter parameters over the course of the experiment.**

152 A) Dissolved organic N, B) dissolved organic P, C-J) fDOM. Values represent the mean of all

153 samples collected from each treatment (n=12). Error bars represent standard error of the mean.

154 fDOM = fluorescent dissolved organic matter humic (A, M, C) and proteinaceous (B and T)

155 components and indices HIX, FI and M:C; Nelson et al 2015, Quinlan et al. 2018). Using the

156 identical models to Figure S2 all parameters show no significant treatment or treatment:time

157 interaction effect ($p > 0.1$).

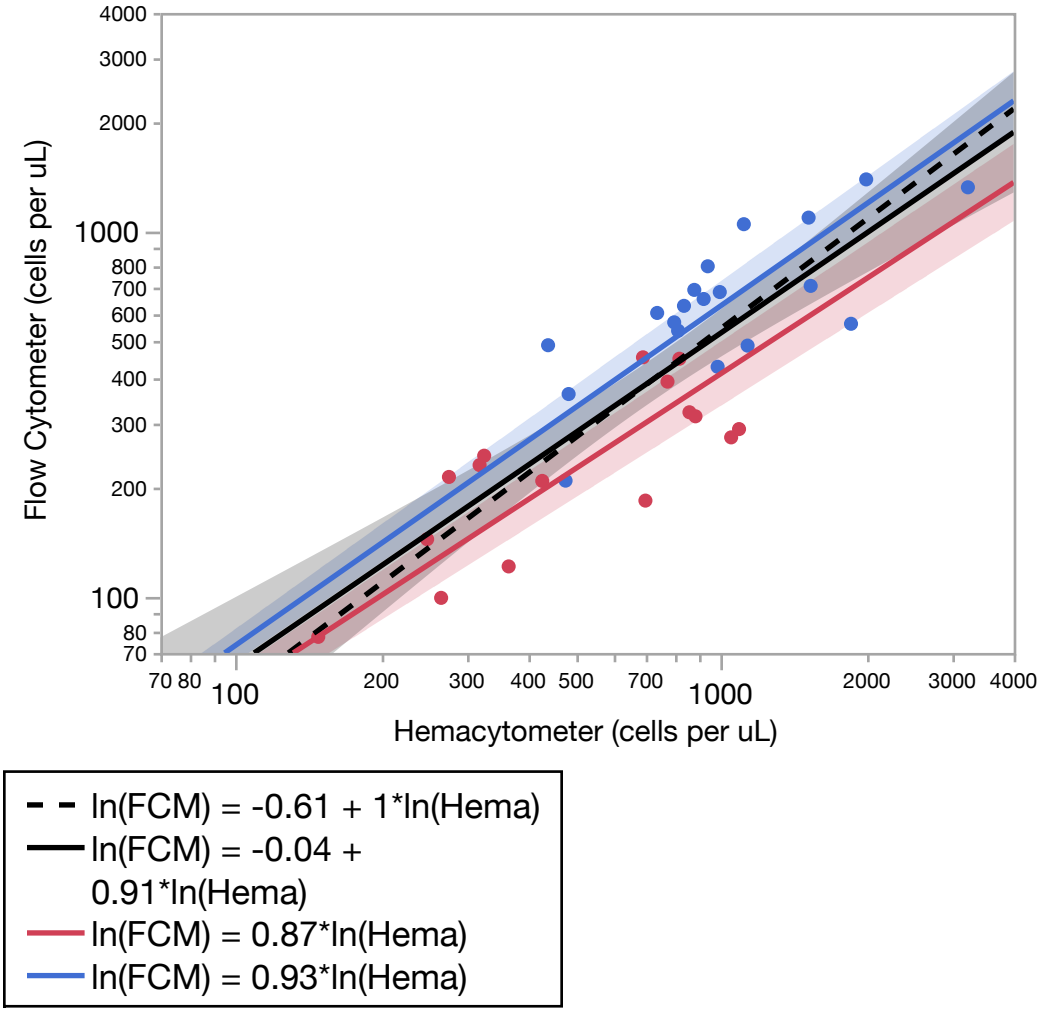


Fig. S5 – Correspondence between flow cytometer (FCM) and hemacytometer (Hema) counts of Symbiodiniaceae cells from identical tissue slurry samples. All regression models, including all data (solid black line) and each genus modeled separately (red = *Pocillopora* and blue = *Porites*) are highly significant ($p < 0.0001$), model slopes do not differ significantly from unity (dashed black line) and there is no significant interaction between genus and Hemacytometer counts in predicting flow cytometer counts, demonstrating that taxa do not differ in methodological offset.

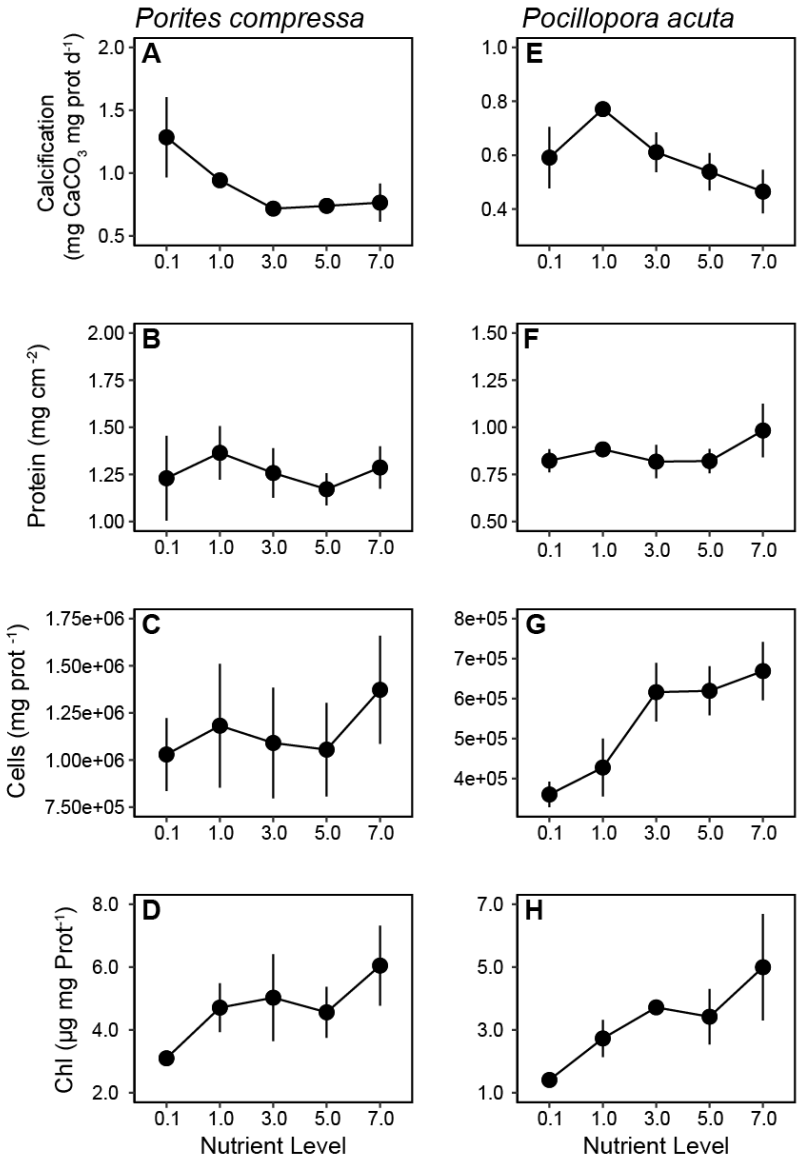
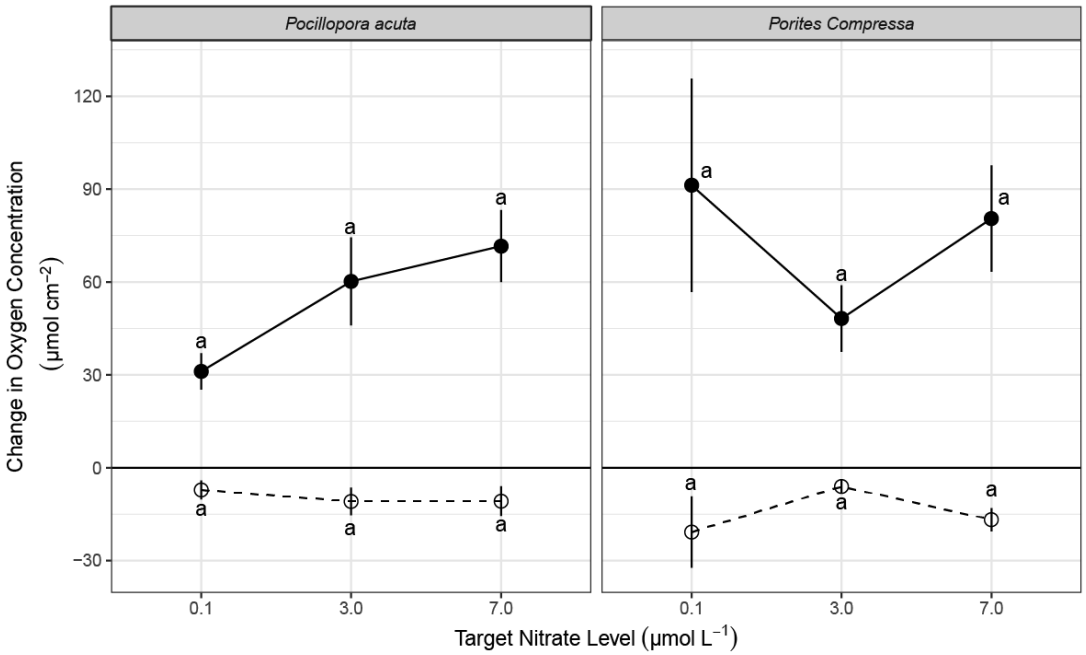


Figure S6 – Physiological response variables standardized to total protein content. A,E) Calcification rate, B,F) total protein content, C,G) endosymbiont density, D,FRAGMENTS) Total chlorophyll content. Nutrient treatment levels are depicted on the x-axis and response variables are presented as the mean of all colonies in a given treatment (n=7 colonies and n=4 replicates per colony). Error bars represent standard error of the mean.



193 **Fig. S7 – Gross photosynthetic (solid line) and respiration rates(dashed line) for each**
194 **species at the end of the experiment.** Error bars represent standard error of the mean
195 and letters denote significant differences between treatments means.

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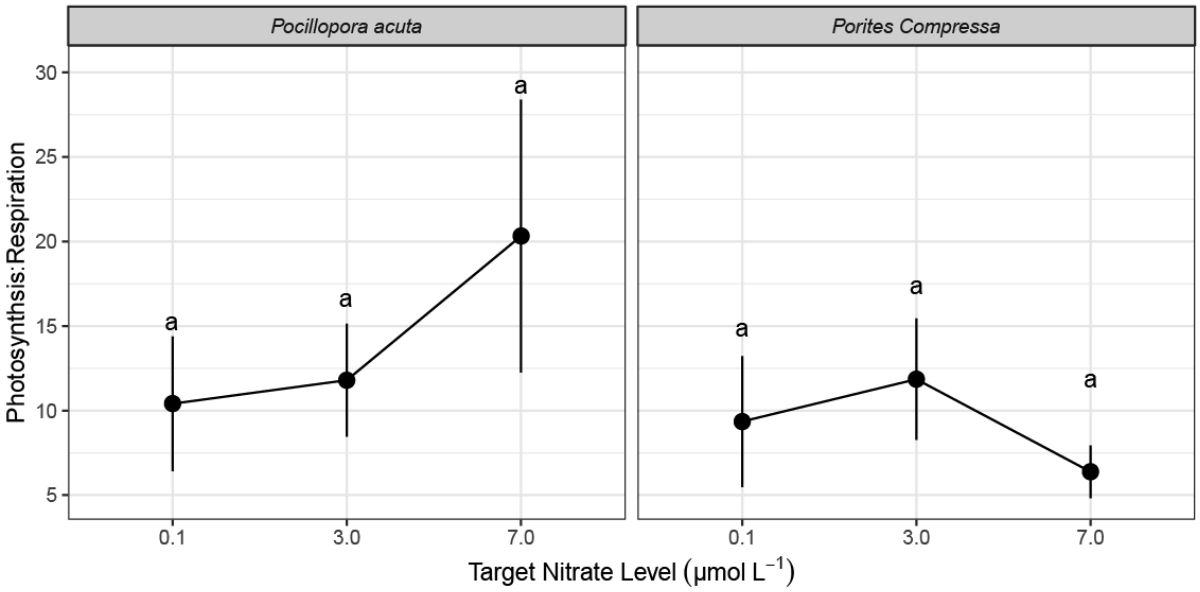

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209 **Fig. S8 – Photosynthesis to respiration ratio for each species at the end of the experiment.**

210 Error bars represent standard error of the mean and letters denote significant differences between

211 treatments means.

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