The following supplement accompanies the article

Facilitation of coral reef biodiversity and health by cave sponge communities

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Supplement.

Table S1. Herbivore diversity near caves. Mean number of herbivores ± 1 SE per 1 m^2 near each of five caves (MC: Mystery Cave; AFBH: Angelfish Blue Hole; RC: Rolleville Cave; SCC: Sugar Cay Crevasses; NPCC: Norman's Pond Cay Cave). Within each column, the upper number represents the number of fish and urchins near the cave mouth, while the lower number represents the number of fish and urchins at far sites (approximately 25 m from the cave mouth). The herbivores at near and far sites were compared using *t*-tests, and the p-value for each is presented. n/a: not applicable (species does not occur at this site)

Species	MC	AFBH	RC	SCC	NPCC
Acanthuridae					
Acanthurus bahianus	14.33±6.06 3.83±2.32 p=0.0020	4.17±3.06 1.0±1.27 p=0.0627	n/a	14.33±5.23 7.50±2.74 p=0.0131	n/a
Acanthurus chirurgus	7.83±3.19 1.33±1.21 p=0.0012	4.83±2.56 0.83±0.98 p=0.0117	n/a	7.67±2.94 3.0±2.45 p=0.0052	n/a
Acanthurus coeruleus	14.33±5.16 3.0±2.61 p=0.0014	9.67±3.26 2.17±1.84 p=0.0081	n/a	20.33±9.31 6.83±6.46 p=0.0132	n/a
Pomacentridae					
Microspathodon chrysurus	n/a	2.83±0.75 1.0±0.63 p=0.0103	n/a	n/a	n/a
Stegastes fuscus	1.33±0.82 0 p=0.0103	n/a	n/a	2.0±0.63 0.50±0.84 p=0.0011	n/a
Stegastes leucostictus	n/a	2.0±0.63 0.50±0.55	1.50±0.55 0.33±0.52	n/a	1.17±0.75 0.83±0.75

		p=0.0071	p=0.0127		p=0.4650
Stegastes planifrons	1.17±0.41 0 p=0.0009	n/a	n/a	1.33±0.82 0.67±0.82 p=0.2856	n/a
Scaridae					
Scarus guacamaia	1.67±1.63 0.50±0.84 p=0.1345	2.67±2.66 1.0±1.27 p=0.2053	n/a	9.33±5.05 2.67±1.21 p=0.0407	n/a
Scarus vetula	n/a	1.83±1.60 0.67±0.82 p=0.1099	1.83±1.17 0.17±0.41 p=0.1747	n/a	0.83±0.75 0.67±0.82 p=0.3632
Sparisoma chrysopterum	n/a	n/a	1.83±2.40 0.17±0.41 p=0.0199	n/a	n/a
Sparisoma viride	2.67±1.51 0.50±0.55 p=0.0062	n/a	n/a	13.0±4.15 3.17±2.23 p=0.0005	1.0±0.89 1.17±0.75 p=0.6952
Echinoidea					
Diadema antillarum	0.42±0.74 0.08±0.33 p<0.0001	n/a	0.92±0.96 0.30±0.53 p=0.0002	0.63±0.88 0.15±0.40 p=0.0005	0.10±0.30 0.17±0.34 p=0.6867
Echinometra lucunter	1.20±0.97 0.30±0.53 p<0.0001	0.83±0.99 0.15±0.40 p=0.0002	n/a	2.27±1.33 0.20±0.44 p<0.0001	0.50±0.75 0.48±0.65 p=0.4475
Echinometra viridis	0.72±0.80 0.20±0.44 p<0.0001	n/a	n/a	1.55±1.10 0.20±0.44 p<0.0001	n/a
Tripneustes ventricosus	n/a	n/a	0.10±0.30 0.58±0.70 p<0.0001	n/a	0.07±0.31 0.20±0.40 p=0.2432

Table S2. Common cave sponges from four caves in the Exumas Archipelago, Bahamas. Caves include: Mystery Cave [MC], Angelfish Blue Hole [AFBH], Rolleville Cave [RC], and Sugar Cay Crevasses [SCC]. The specific location within each cave (M = mouth, C = center, B = back) is indicated; however, when the distribution crosses two zones or when multiple caves are indicated, additional locations are noted as appropriate. The majority of the sponge biomass represents an encrusting morphology, although this can often take the form of a "thick crust" (defined here as >1 cm from the substrate), while other growth forms account for <25% of the percent cover but >75% of the biomass. Norman's Pond Cay Cave [NPCC] was recently invaded by an unidentified Spirastrellid, but three individuals account for <80 cm^2 combined encrusted surface area. Bacterial abundance (HMA = high microbial abundance [$\geq 10^8$ cells g^{-1} tissue]; LMA = low microbial abundance [$\leq 10^6$ cells g^{-1} tissue]) reported here is based on ([a])published results[1], ([b])personal observations of histological preparations, or ([c])inferences from mesohyl density and/or familial relationships

Family	Species	Morphology	Microbial abundance	Cave	Location
Agelasidae	*Agelas clathrodes*	fan	HMA[a]	MC, AFBH, RC	C, B
Ancorinidae	*Penares mastoidea*	massive		MC, AFBH	B
	Asteropus cf syrigiferus	encrusting		MC	B
Aplysinidae	*Aiolochroia crassa*	massive	HMA[a]	AFBH, SCC	M
	Aplysina lacunosa	lobate	HMA[a]	AFBH, RC, SCC	C
Axinellidae	*Dragmacidon reticulatum*	fan	HMA[b]	AFBH, SCC, RC	C, B
	Pseudoaxinella cf grayi	bushy		MC	B
Callyspongidae	*Callyspongia fallax*	massive	LMA[c]	MC, AFBH	C, B
Chalinidae	*Chalinula moltiba*	branching		MC, RC	M, C
	Chalinula cf moltiba	branching		MC	B
	Haliclona implexiformis	massive	LMA[b]	MC, SCC, AFBH	M, C
	Soestella novum species	branching		MC	B

[1]Weisz JB, Lindquist N, Martens CS (2008) Do associated microbial abundances impact marine demosponge pumping rates and tissue densities. Oecologia 155:367–376

Chondrillidae	*Chondrilla novum species*	thick crust	HMA[c]	MC	M, C
	Chondrilla nucula	thick crust	HMA[b]	RC, SCC	M
	Chondrosia collectrix	thick crust	HMA[c]	MC, AFBH	B
Clathrinidae	*Clathrina coriacea*	spherical		MC	B
Crambeidae	*Monanchora arbuscula*	encrusting		AFBH, RC	C
Darwinellidae	*Chelonaplysilla erecta*	thick crust		AFBH, RC	C, B
Esperiopsidae	*Scopalina ruetzleri*	cactus	LMA[c]	MC, AFBH	M, C
	Scopalina cf hispida	cactus	LMA[c]	MC	B
Geodiidae	*Erylus formosus*	thick crust		AFBH, SCC	M
Iotrochotidae	*Iotrochota birotulata*	encrusting	LMA[a]	AFBH, SCC	M, C
Leucettidae	*Leucetta imberbis*	spherical		MC	B
Microcionidae	*Clathria schoenus*	encrusting		RC, SCC	M, C
Mycalidae	*Mycale laxissima*	encrusting	LMA[a]	AFBH, RC	C
Niphatidae	*Amphimedon compressa*	thick crust	LMA[a]	MC, AFBH, RC	M
	Amphimedon novum species	bushy	LMA[c]	MC	C
	Niphates sp.	encrusting	LMA[b]	RC	C
Phloeodictyidae	*Pellina carbonaria*	massive		MC	B
	Pellina pencilliformis	branching		AFBH, RC	M, C
Plakinidae	*Plakortis angulospiculata*	thick crust	HMA[b]	AFBH, RC, SCC	M
	Plakortis novum species	thick crust	HMA[b]	MC	M
	Plakinastrella onkodes	lobate	HMA[c]	MC, RC, AFBH	C, B
	Oscarella cf viridis	encrusting		MC, AFBH	C
Spirastrellidae	*Diplastrella cf megastrellata*	encrusting		MC	C

	Spirastrella cuncutrix	encrusting		MC, AFBH	C
Spongidae	*Spongia obscura*	massive		MC, AFBH	C, B
Suberitidae	*Prosuberites geracei*	thick crust		RC	C
Tedaniidae	*Tedania ignis*	massive	LMA[a]	MC, AFBH	C, B
	Hemitedania novum species	massive	LMA[c]	MC	C
Tethyidae	*Tectitethya crypta*	massive	HMA[b]	RC	M
	Tethya diploderma	spherical	LMA[b]	MC, AFBH	C
	Tethya novum species	spherical	LMA[c]	MC	M
Tetellidae	*Cinachyra subterranea*	spherical	HMA[b]	AFBH, RC	B
	Cinachyrella kukenthali	spherical	HMA[b]	MC, AFBH, RC	C, B
Thorectidae	*Hyrtios cavernosa*	thick crust	HMA[b]	RC, SCC	C

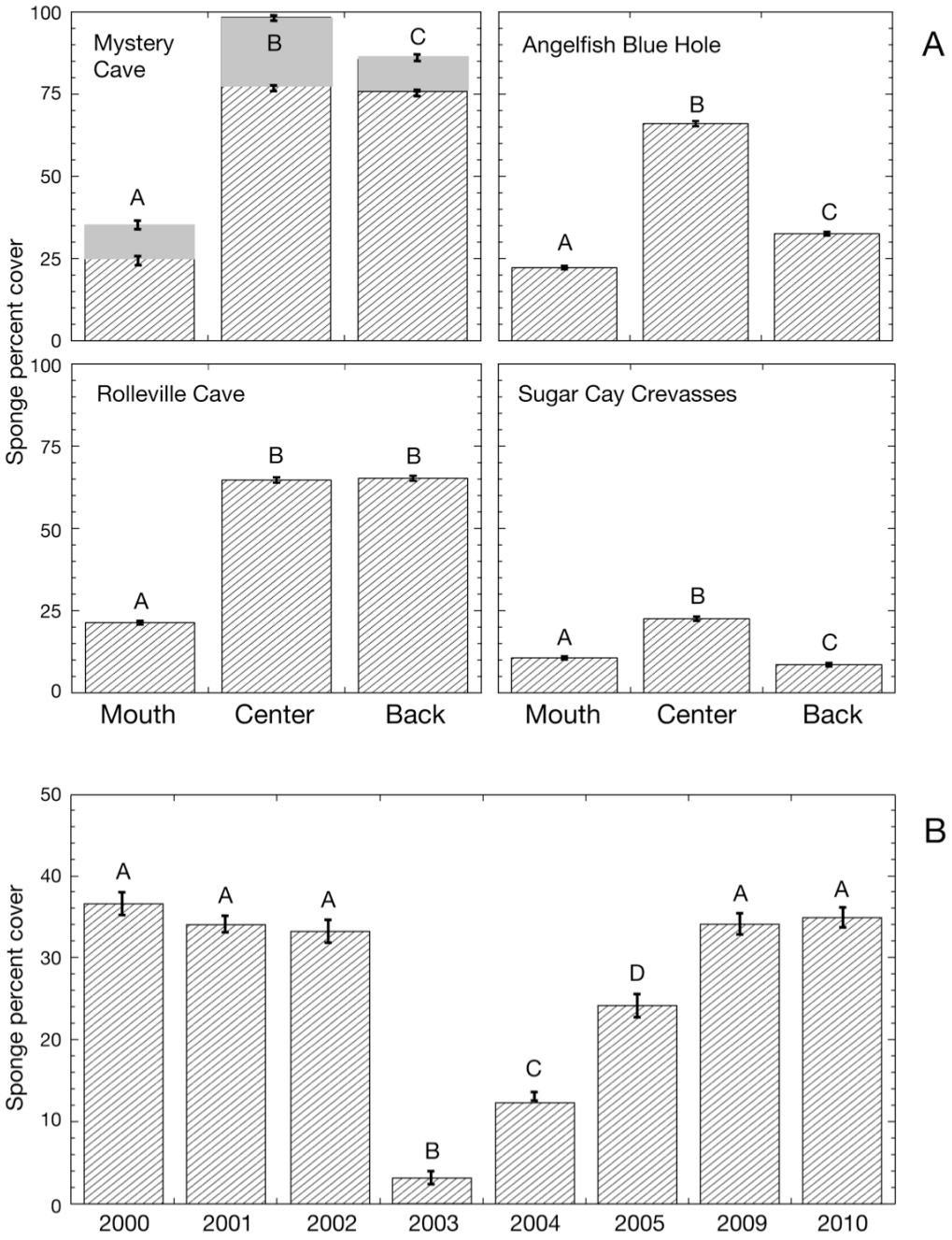

Fig. S1. A) Percent cover of sponges on cave walls. Data were collected annually between 2000 and 2005 (n=30, 0.25 m^2 quadrats at each of three locations within the cave: mouth, center and back), but there was no significant time effect, so samples from all 6 years within each cave were pooled. Thus, bars represent the mean percent sponge cover ± 1 SE in 0.25 m^2 quadrats (n=180 per distance; for MC the data are presented with/without 2003 replicates to show the effects of sediment scour on the cumulative percent cover). Stacked bars at MC indicate the percent cover exclusive of the 2003 dataset (hatched + shaded bars) or inclusive of 2003 dataset (hatched bars only). B) Percent cover of sponges on MC mouth walls through time. Data from 2000 to 2002 are from the same 0.25m^2 quadrats reported above. Following the dredging event in Oct–Nov 2002, additional 0.25m^2 quadrats (n=30), representative of sponge scoured substrate, were identified and marked with stainless steel spikes for annual sponge recovery surveys. Sites within the cave (A) or between years (B) that differ significantly (Scheffe's test, $p \leq 0.05$) in percent sponge cover are indicated by different letters above bars. Note: Norman's Pond Cay Cave is not included since the few small sponges that have recently invaded this cave did not occur in any of our quadrats

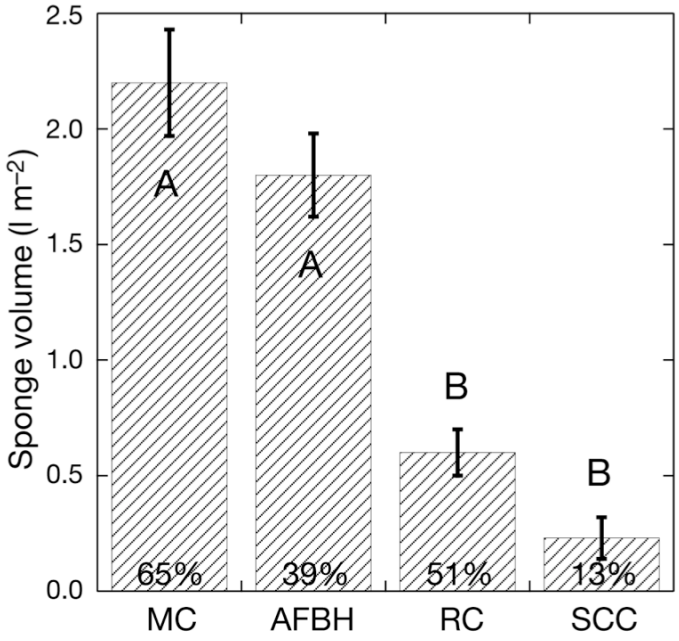

Fig. S2. Sponge biomass within four caves. Data were collected in 2000 from quadrats within each cave zone (n=10 replicates per zone), which provided a representative sampling of all sponges (i.e., facultative and obligate cave species). Caves: Mystery Cave (MC), Angelfish Blue Hole (AFBH), Rolleville Cave (RC), and Sugar Cay Crevasses (SCC). Data: mean ± 1 SE; percent values: average percent cover from each of the caves. Caves that differ significantly (Scheffe's test, $p \leq 0.05$) in sponge biomass are indicated by different letters

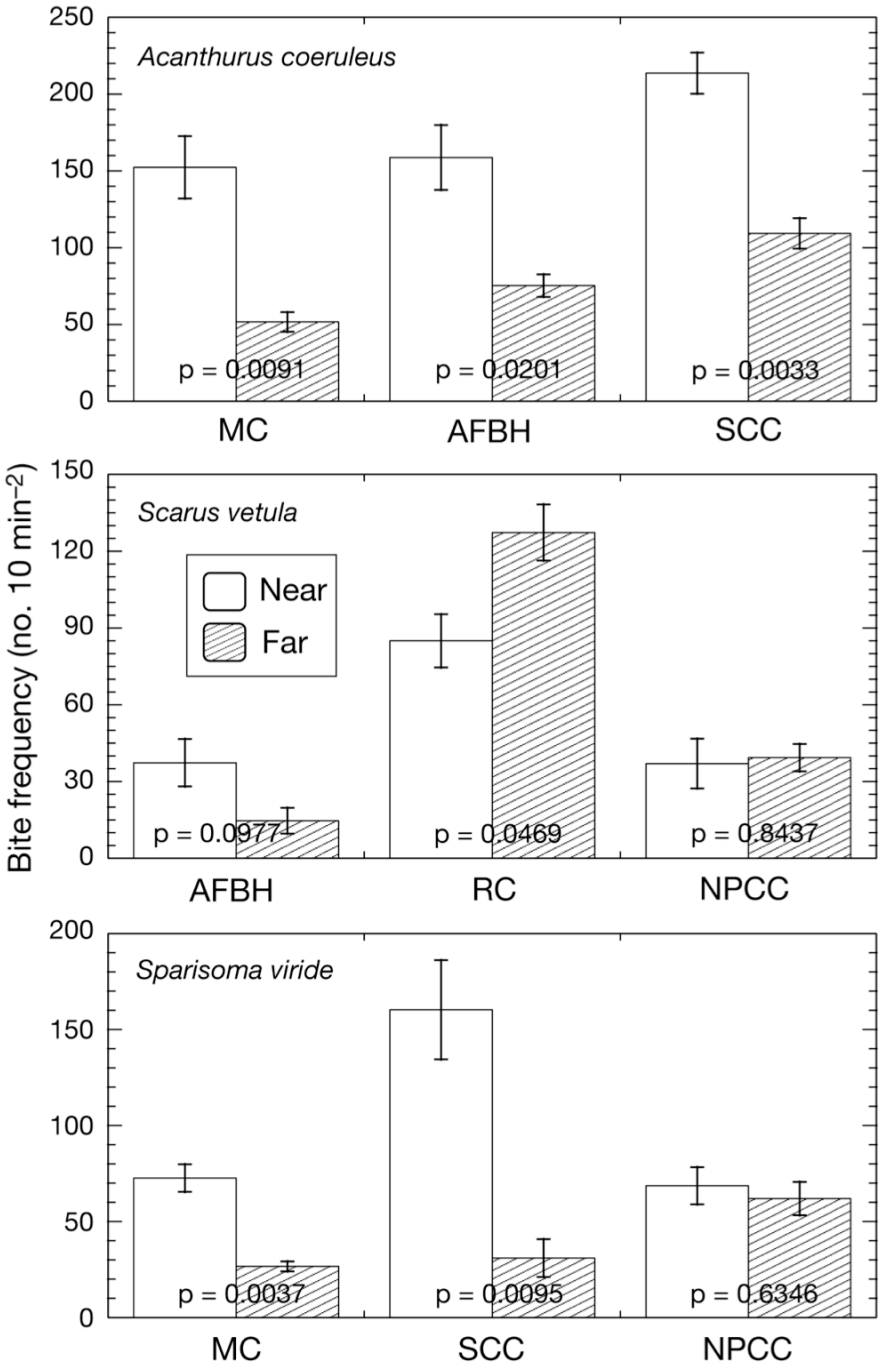

Fig. S3. Rates of herbivory near and far from the mouths of caves. Data represent the mean number of bites ± 1SE in a ten-minute period (n=5 periods per distance in each of three successive years: May 2000 to 2002) by the most common herbivorous fish species at each cave site. Note: there was no significant difference in feeding rates between years, as measured by bites per unit time, so the data were pooled and tested using unpaired *t*-tests

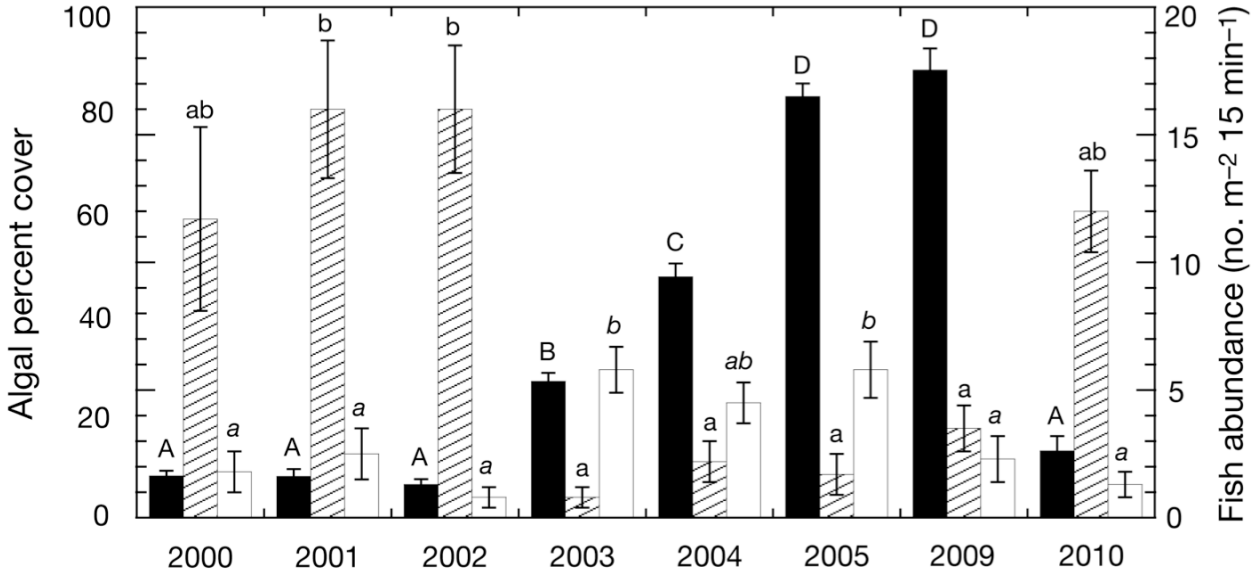

Fig. S4. Algal percent cover and number of herbivorous fish through time. Filled bars represent the mean percent cover of algae/cyanobacteria ± 1 SE per 1 m^2 near the mouth of Mystery Cave. Hatched and open bars represent the mean number of herbivorous fishes (= acanthurids and scarids) ± 1 SE per 1 m^2 observed during a 15 min time period near the mouth of Mystery Cave and Angelfish Blue Hole, respectively. Statistically significant differences in algal percent cover or numbers of fish at each cave mouth, through time, are designated by different letter groups above the bars. Note that harbor dredging (in Oct–Nov 2002), and subsequent sediment scour of the cave sponge communities occurred after the May 2002 sampling period and prior to the dramatic increase in algal cover

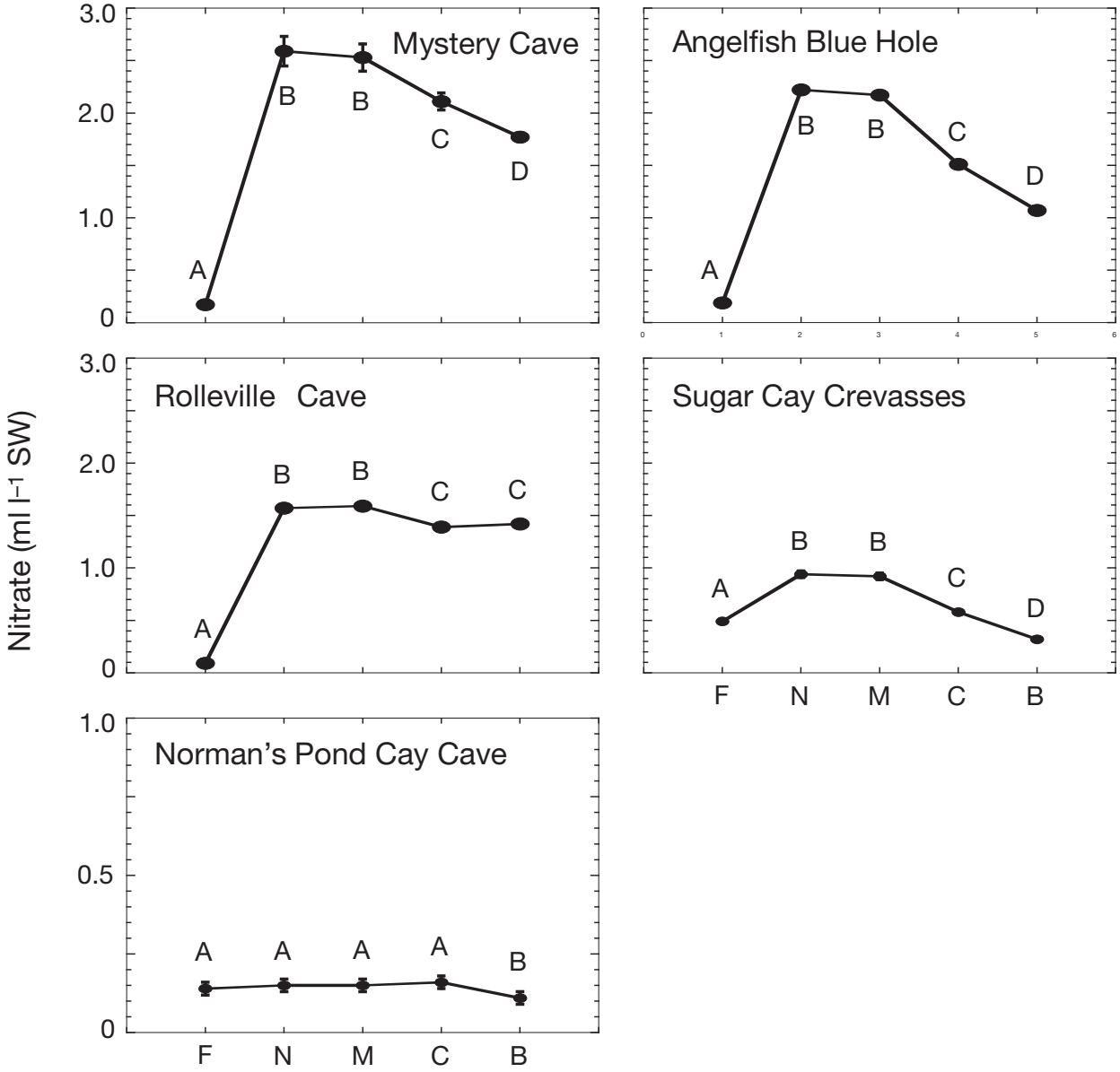

Fig. S5. Nitrate concentrations in seawater near caves and within caves. Data points represent the mean concentration of nitrate ± 1 SE (n=10 replicates per site; note that some error bars are smaller than the marker). Sites include: outside cave approximately 25 m from mouth (= far: F), outside cave mouth (= near: N), inside cave mouth (M), center of cave (C), and back of cave (B); see 'Materials and methods: Surveys' in the main article for further clarification of these cave zones. Sites that differ significantly (Scheffe's test, $p \leq 0.05$) in nitrate concentration are indicated by different letters

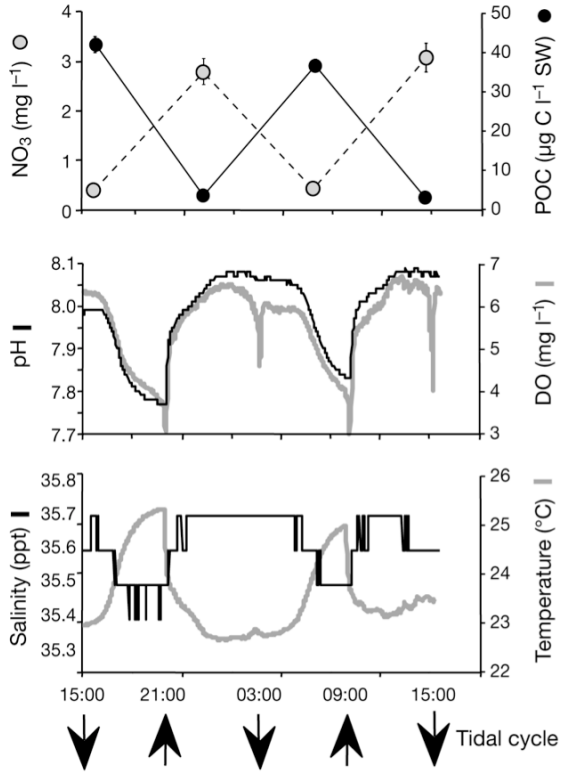

Fig. S6. Representative 24-hour moored Hydrolab dataset. Oceanographic water parameters were collected from Mystery Cave on 10-11 January 2003, and plotted against the average nitrate and particulate organic carbon levels at ebb [↓] and flood [↑] tides, providing a visual overview of nutrient and energy flux. SW = seawater

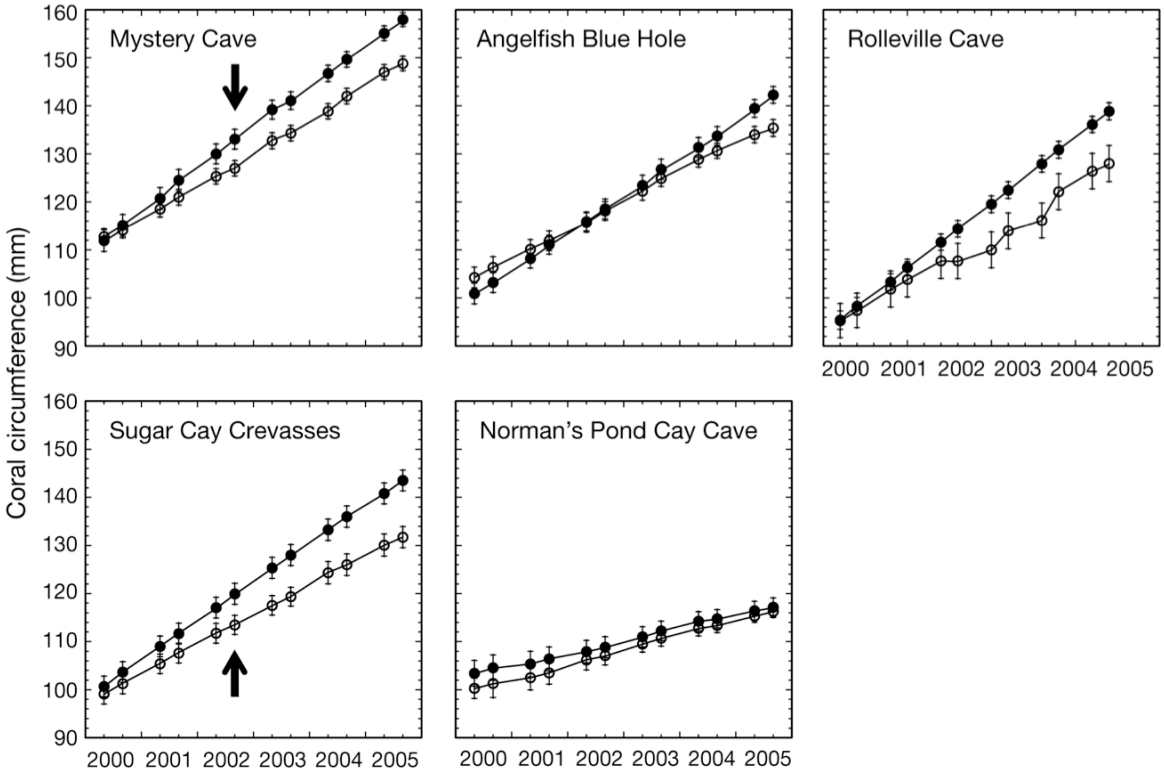

Fig. S7. *Siderastrea radians* growth near and far from the mouths of caves. Points represent the mean coral circumference ± 1 SE of marked individuals in January and May of 2000 through 2005 (n=11-15 colonies at near sites [closed circles] and 8-15 colonies at far sites [open circles]). Arrows represent the point at which coral growth at near and far sites first exhibited significant differences (Scheffe's test, $p \leq 0.05$)

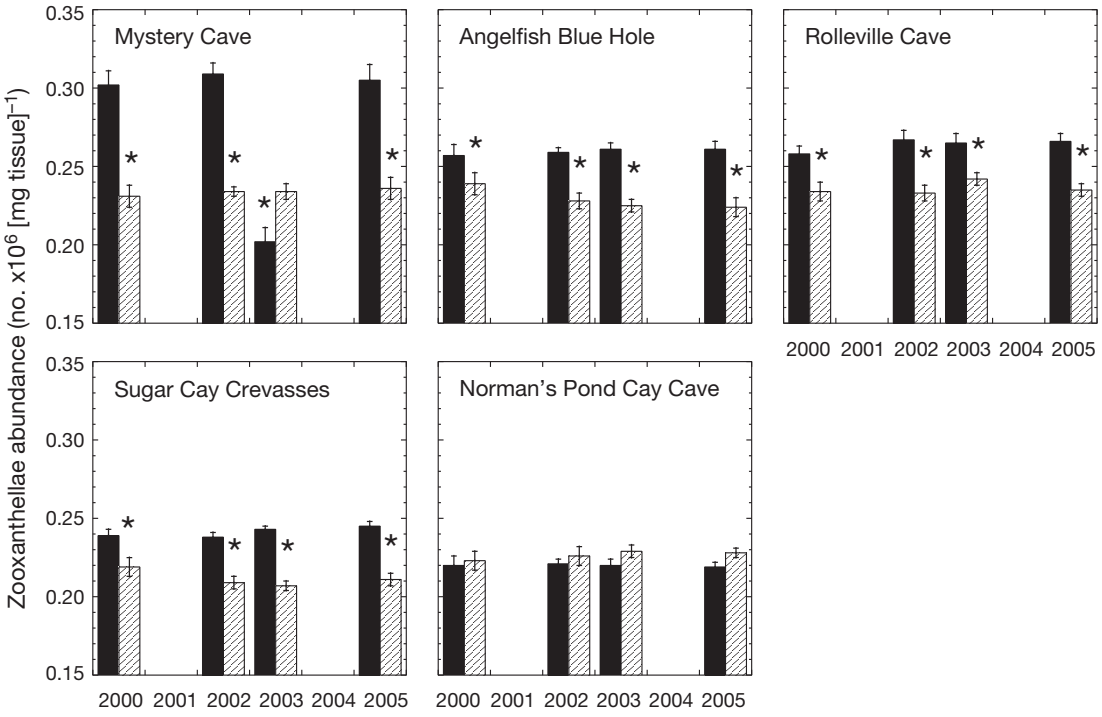

Fig. S8. *Siderastrea radians* zooxanthellae density near and far from the mouths of caves. Bars represent the mean zooxanthellae density ± 1 SE for marked coral colonies in January and May of 2000 through 2005 (n=11-15 colonies at near sites [filled bars] and 8-15 colonies at far sites [hatched bars]). Samples were not collected in 2001 and 2004 to limit the effects of regeneration on growth parameters. Caves that exhibited significant differences (Scheffe's test, p≤0.05) in zooxanthellae density, at near and far sites, are indicated by an asterisk (*)

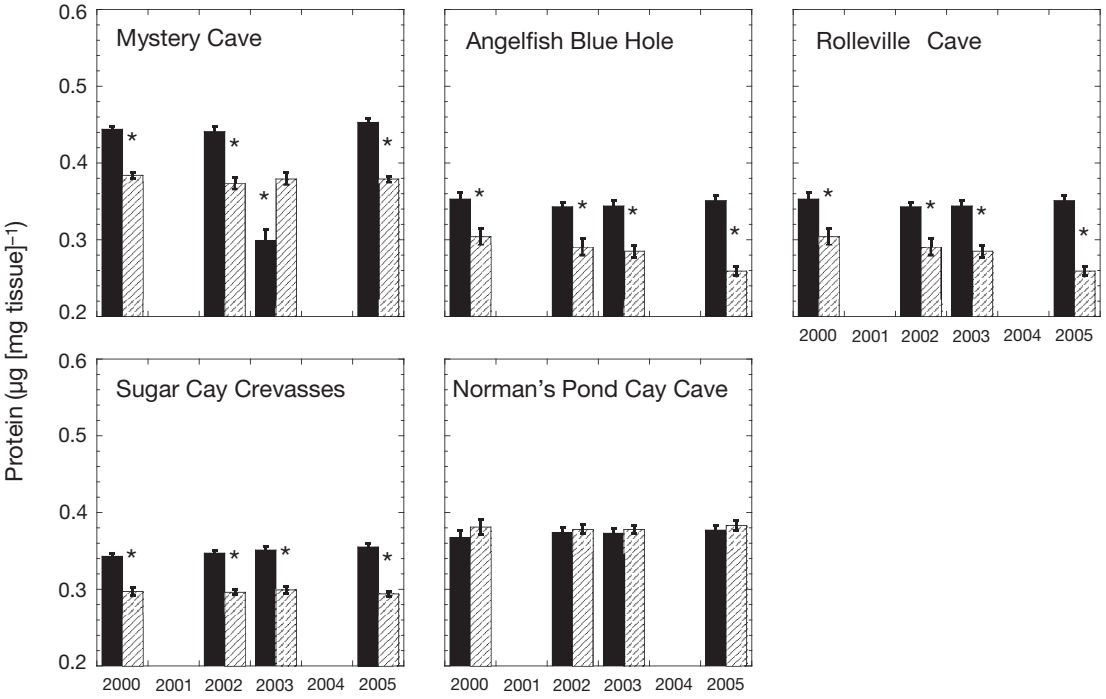

Fig. S9. *Siderastrea radians* protein concentrations near and far from the mouths of caves. Bars represent the mean protein content ± 1SE for marked coral colonies in January and May of 2000 through 2005 (n=11-15 colonies at near sites [filled bars] and 8-15 colonies at far sites [hatched bars]). Samples were not collected in 2001 and 2004 to limit the effects of regeneration on growth parameters. Caves that exhibited significant differences (Scheffe's test, p≤0.05) in protein content, at near and far sites, are indicated by an asterisk (*)