Supporting Information

Kroeker et al. 10.1073/pnas.1216464110

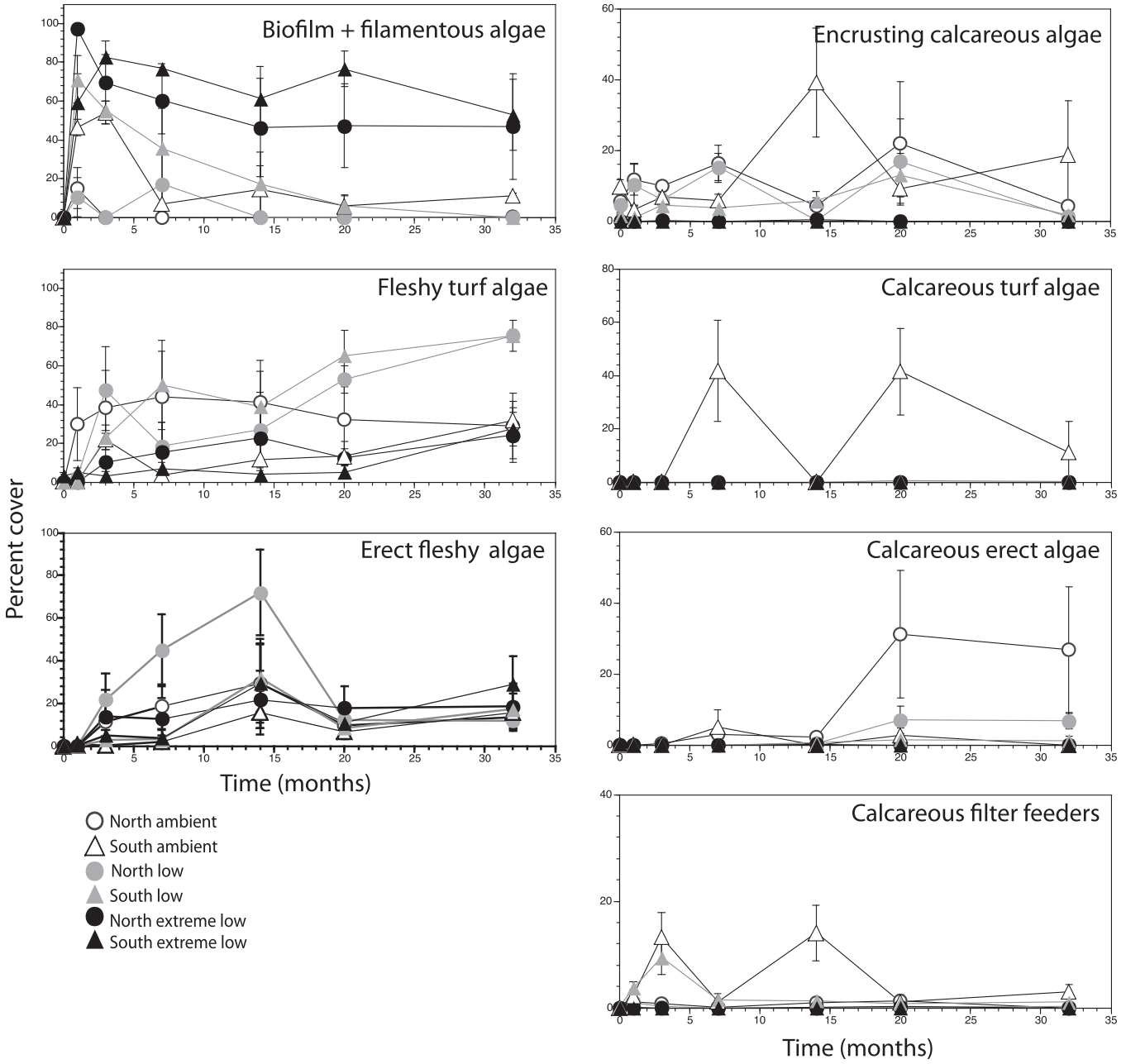

Fig. S1. Percent cover of key functional groups through time. Functional groups include those that contributed to >75% of the dissimilarity between pH zones. Noncalcareous taxa are found on the *Left*, whereas calcareous taxa are grouped together on the *Right*.

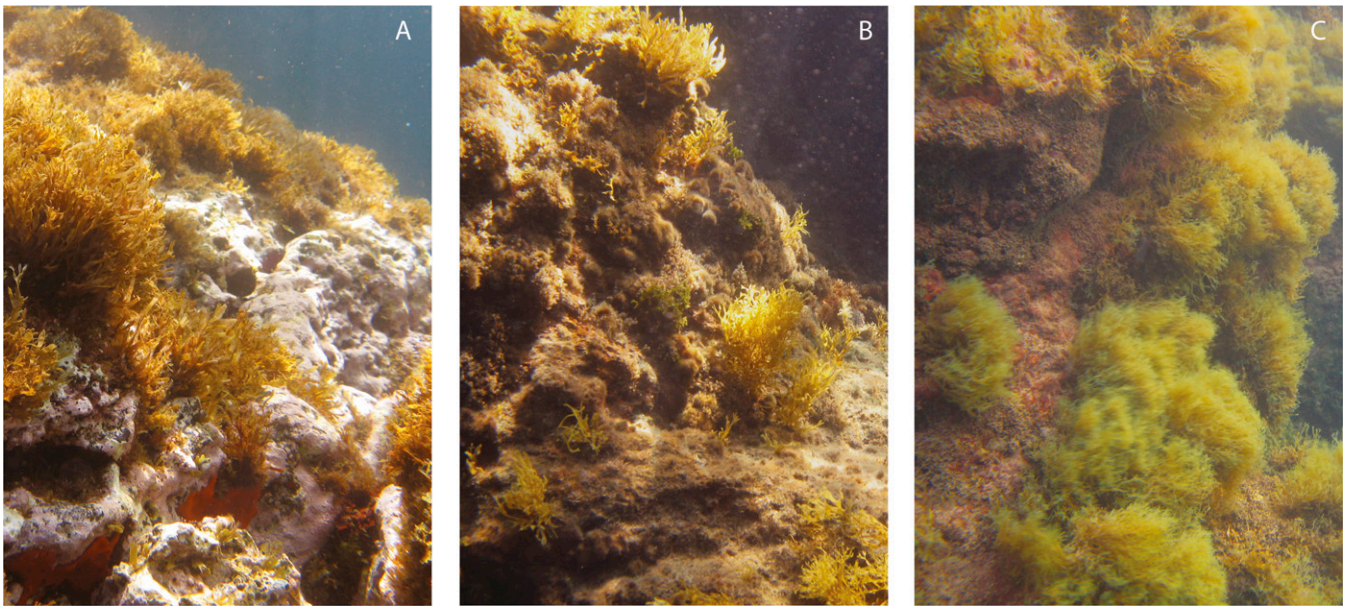

Fig. S2. Photographs taken of the background communities in each pH zone. (*A*) Ambient, (*B*) low, and (*C*) extreme low pH zones. The photos highlight (*A*) the presence of sea urchin halos and habitat patchiness in ambient pH, (*B*) low variability in community structure and high percent cover of fleshy turf algae in low pH, and (*C*) the depauperate communities in extreme low pH dominated by biofilm/filamentous algae and erect fleshy algae.

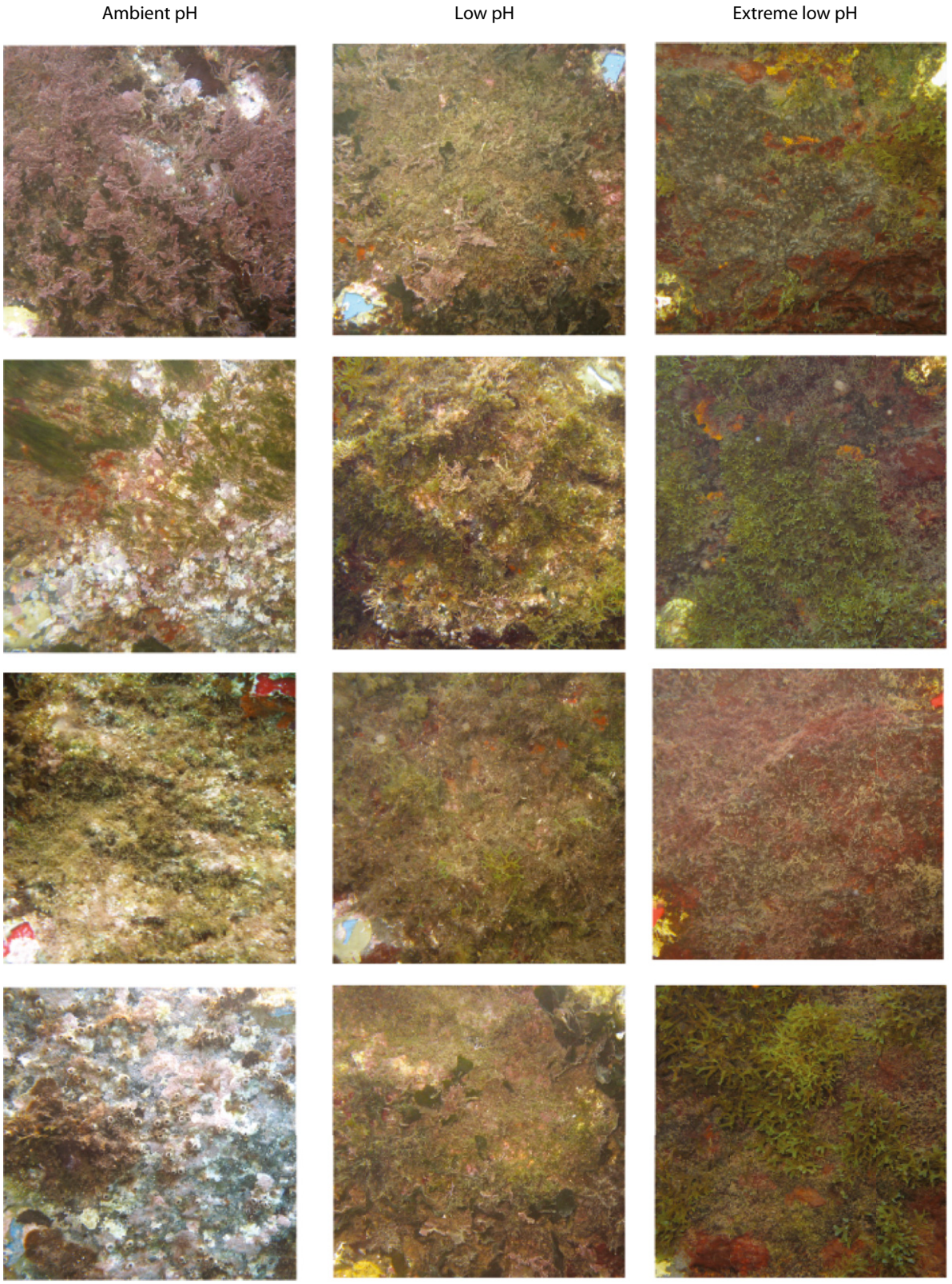

Fig. S3. Photos of a random subset of plots from each pH zone after 32 mo of recovery. Photos highlight the variability in assemblages in ambient pH versus the homogeneity of assemblages in low and extreme low pH.

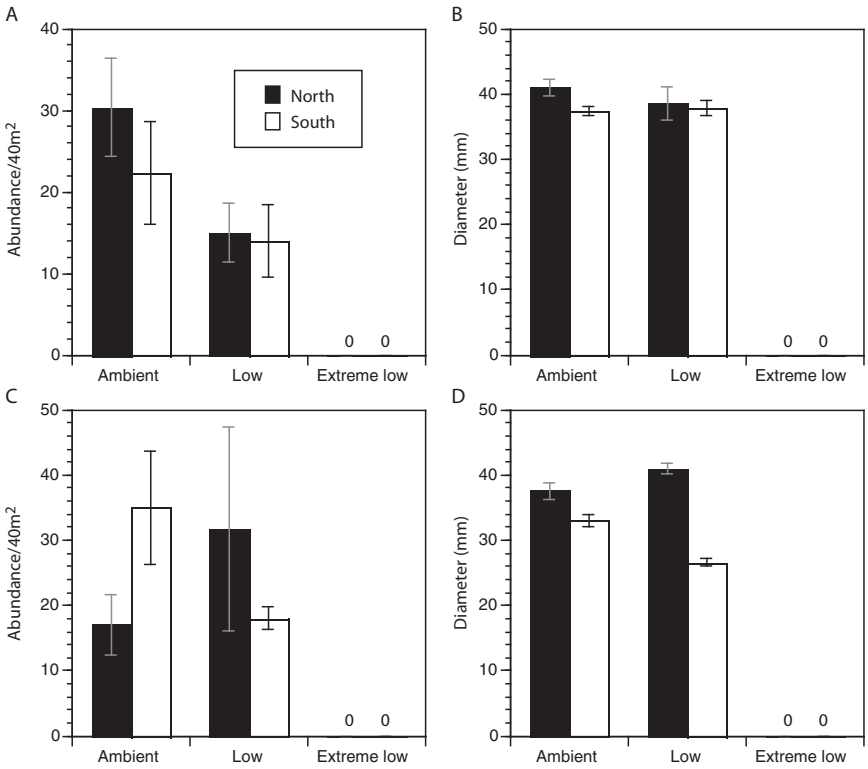

Fig. S4. Abundance (*A* and *C*) and size (*B* and *D*) of *A* and *B Arbacia lixula* and *C* and *D Paracentrotus lividus* urchins in each site x pH zone. Means ± SEM, $n = 4$, based on repeated measurements in each site x pH zone in June 2009, October 2009, May 2010, and October 2010. We did not detect any significant differences ($\alpha = 0.05$) between sites or pH zones.

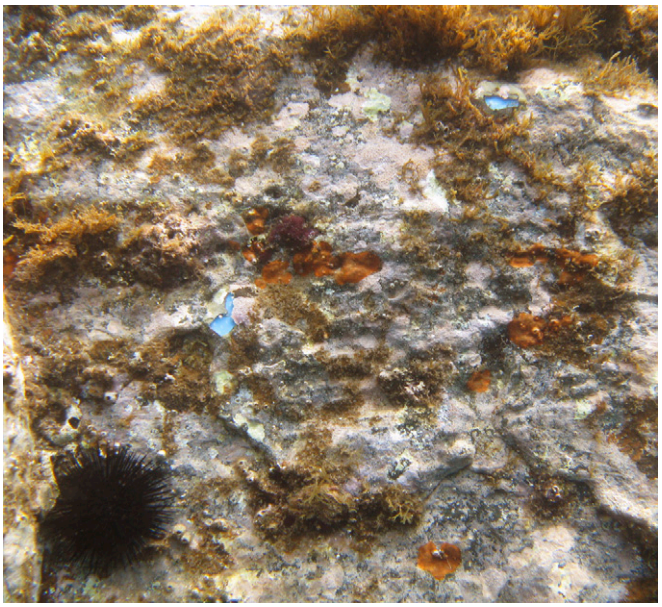

Fig. S5. *Arbacia lixula* near a plot in ambient pH with high percent cover of CCA. The two blue markers identify the corners of the 20 × 20 cm plot.

Table S1. Dominant species in functional groups

Functional group	Dominant taxa
Biofilm/filamentous algae	Cyanobacteria, unclassified filamentous algae
Encrusting fleshy algae	*Hildebrandia rubra, Ralfsia verrucosa*
Encrusting calcareous algae	Unclassified crustose coralline algae
Fleshy turf algae	*Cladophora* sp., *Bryopsis* sp., *Halopteris* sp., *Feldmannia* sp.
Calcareous turf algae	*Haliptilon* sp.
Erect fleshy algae	*Dictyota dichotoma*, *Dictyota linearis*, *Flabellia petiolata, Codium bursa, Bryopsis* sp., *Halopteris* sp.
Erect calcareous algae	*Corallina elongata*, *Jania rubens*, *Amphiroa rigida*, *Padina pavonica*
Calcified filter feeders	*Balanus perforatus*, *Spirorbis* sp., unclassified bryozoans
Sponges	Unclassified

Table S2. Statistical tests of differences (PERMANOVA) and variability (PERMDISP) in community structure 32 mo postclearing

	df	SS	MS	*F*	*T*	*P*	No. permutations
PERMANOVA results (source)							
Site	1	1,225.5	1,225.5	1.26		0.3	9,949
pH	2	15,572	7,786.2	8.01		0.0005	9,946
Site × pH	2	1,930.1	965.03	0.99		0.4	9,937
Residual	18	17,496	972.02				
Total	23	36,224					
Pairwise comparisons							
Ambient × low					2.35	0.0001	9,946
Low × extreme low					3.64	0.002	9,954
Ambient × extreme low					2.39	0.005	9,951
PERMDISP (dispersion)							
pH	2			8.88		0.004	
Pairwise comparisons							
Ambient × low					4.77	0.0004	9,999
Low × extreme low					3.62	0.002	9,999
Ambient × extreme low					0.24	0.8	9,999

Table S3. Statistical tests of differences (PERMANOVA) and variability (PERMDISP) in recovery trajectories

	df	SS	MS	*F*	*T*	*P*	No. permutations
PERMANOVA results (source)							
Site	1	0.13154	0.13154	0.91		0.5	9,965
pH	2	0.7408	0.3704	2.56		0.02	9,936
Site × pH	2	0.50459	0.2523	1.74		0.1	9,956
Residual	18	2.6093	0.14496				
Total	23	3.9863					
Pairwise comparisons							
Ambient × low					1.06	0.4	9,950
Low × extreme low					2.42	0.002	9,955
Ambient × extreme low					1.62	0.056	9,952
PERMDISP (dispersion)							
pH	2			14.92		0.0002	
Pairwise comparisons							
Ambient × low					4.52	0.003	9,999
Low × extreme low					0.49	0.7	9,999
Ambient × extreme low					4.67	0.001	9,999

Table S4. Statistical tests of differences in amount of community change through time (distance traveled in 2D nMDS space)

ANOVA results (source)	df	SS	MS	*F*	*T*	*P*	No. permutations
Site	1	0.32	0.32	0.23		0.6	9,833
pH	2	15.29	7.64	5.42		0.01	9,938
Site × pH	2	8.38	4.19	2.98		0.07	9,952
Residual	18	25.35	1.41				
Total	23	49.35					
Pairwise comparisons							
Ambient × low					0.69	0.5	9,837
Low × extreme low					2.67	0.02	9,830
Ambient × extreme low					2.89	0.01	9,832

Table S5. RM-ANOVA results for mean abundance and size of urchins

Source	df	MS	*F*	*P*
Arbacia lixula abundance				
Between subjects				
pH	1	333.06	4.109	0.18
Error	2	81.06		
Within subjects				
Date	3	54.06	3.88	0.03*
Date × pH	3	48.73	12.51	0.03*
Error	6	3.9		
Paracentrotus lividus abundance				
Between subjects				
pH	1	121	0.429	0.58
Error	2	282.25		
Within subjects				
Date	3	193.17	2.23	0.24*
Date × pH	3	285.17	3.29	0.16*
Error	6	86.75		
Arbacia lixula size				
Between subjects				
pH	1	4.15	0.31	0.64
Error	2	13.37		
Within subjects				
Date	3	3.23	0.21	0.76*
Date × pH	3	3.5	0.229	0.74*
Error	6	15.35		
Paracentrotus lividus size				
Between subjects				
pH	1	6.83	0.04	0.86
Error	2	170.6		
Within subjects				
Date	2	2.63	0.565	0.53*
Date × pH	2	1.52	0.327	0.63*
Error	4	4.662		

*GG adjusted *P* value.

Table S6. Seawater pH statistics for approximate month-long sensor deployments across years and seasons

	Ambient	Low	Extreme low	Control
South: 10/7/2009				
Mean	8.00	7.83	—	—
SD	0.07	0.31	—	—
CV	0.01	0.04	—	—
South: 2/1/2010				
Mean	—	7.71	6.56	—
SD	—	0.39	0.49	—
CV	—	0.05	0.08	—
South: 5/1/2010				
Mean	8.07	7.83	6.37	—
SD	0.09	0.26	0.34	—
CV	0.01	0.03	0.05	—
South: 10/1/2010				
Mean	8.04	7.84	6.78	8.04
SD	0.09	0.24	0.67	0.02
CV	0.01	0.03	0.10	0.002
North: 9/1/2010				
Mean	7.96	7.77	7.21	—
SD	0.06	0.19	0.34	—
CV	0.01	0.02	0.05	—

The control site was taken at over 4 km away from the vent sites in a rocky reef community at 1.5-m depth.