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APPENDIX B. Tables showing analyses of variance and repeated-measures analyses of variance testing the effects of productivity, herbivore regime, and ENSO phase on percent cover and frond length through time and as an overall average, and Kruskal-Wallis tests of differences in biomass among different function groups among productivity and grazing regimes.

TABLE B1. ANOVA to test the effect of productivity level (location) and herbivory on (A) percent cover of functional groups of sessile organisms and (B) on frond length of functional groups of algae at the onset of the experiment (January 2006-T0).

(A) Percent cover

		<i>Ulva</i> spp.			articulated coralline algae		
Source	df	MS	<i>F</i>	<i>p</i>	MS	<i>F</i>	<i>p</i>
Productivity	2	1.420	58.527	<0.0001	0.139	24.476	<0.0001
Herbivory	3	0.003	0.126	0.943	0.002	0.378	0.770
Productivity*Herbivory	6	0.001	0.026	1.000	0.002	0.403	0.863
Error	12	0.024			0.006		
		R <sup>2</sup> : 0.907			R <sup>2</sup> : 0.864		
		filamentous algae (reds + greens)			crustose algae		
Source	df	MS	<i>F</i>	<i>p</i>	MS	<i>F</i>	<i>p</i>
Productivity	2	0.180	33.348	<0.0001	1.132	37.668	<0.0001
Herbivory	3	0.002	0.297	0.827	0.005	0.178	0.910

Productivity*Herbivory	6	0.002	0.310	0.919	0.003	0.114	0.993
Error	12	0.005			0.030		
		R <sup>2</sup> : 0.853			R <sup>2</sup> : 0.864		
		corticated algae			sessile invertebrates		
<b>Source</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>	<b>MS</b>	<b>F</b>	<b>p</b>
Productivity	2	0.033	7.999	0.006	0.032	22.793	<0.0001
Herbivory	3	0.001	0.252	0.859	0.001	0.827	0.504
Productivity*Herbivory	6	0.005	1.301	0.328	0.001	0.794	0.592
Error	12	0.004			0.001		
		R <sup>2</sup> : 0.672			R <sup>2</sup> : 0.815		

## (B) Frond Length

		<i>Ulva spp.</i>			filamentous green		
<b>Source</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>	<b>MS</b>	<b>F</b>	<b>p</b>
Productivity	2	0.17	56.752	<0.0001	0.123	4.328	0.038
Herbivory	3	0.001	0.179	0.909	0.002	0.057	0.981
Productivity*Herbivory	6	<0.0001	0.104	0.994	0.001	0.044	0.999

Error	12	0.003			0.029		
		R <sup>2</sup> : 0.905			R <sup>2</sup> : 0.660		
		filamentous red			articulated coralline algae		
<b>Source</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>	<b>MS</b>	<b>F</b>	<b>p</b>
Productivity	2	0.074	13.889	0.001	0.037	19.028	<0.0001
Herbivory	3	<0.0001	0.019	0.996	0.001	0.523	0.675
Productivity*Herbivory	6	<0.0001	0.017	1.000	0.001	0.585	0.736
Error	12	0.005			0.002		
		R <sup>2</sup> : 0.700			R <sup>2</sup> : 0.782		

TABLE B2. Repeated-measures ANOVA to test the effect of productivity and herbivory on percent cover of functional groups of sessile organisms.

<i>A. Filamentous algae</i>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						
Productivity	1	2.479	19.824	<0.0001						
Herbivory	1	1.058	8.455	0.009						
Productivity*Herbivory	1	1.202	9.609	0.006						
Error	20	0.125								

<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.023	1.870	0.059	0.113	0.079	0.285	9.000	3.350	0.027
Time*Productivity	9	0.038	3.073	0.002	0.016	0.005	0.311	9.000	2.953	0.042
Time*Herbivory	9	0.012	0.966	0.469	0.438	0.458	0.528	9.000	1.194	0.379
Time*Productivity*Herbivory	9	0.021	1.664	0.101	0.157	0.122	0.427	9.000	1.788	0.172
Error	180	0.012								
Greenhouse-Geisser Epsilon: 0.5101										
Huynh-Feldt Epsilon: 0.7800										
<i>B. Corticated algae</i>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						
Productivity	1	0.155	3.532	0.075						
Herbivory	1	0.497	11.348	0.003						
Productivity*Herbivory	1	0.207	4.728	0.042						
Error	20	0.044								
<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.014	1.843	0.063	0.145	0.121	0.371	9.000	2.261	0.094

Time*Productivity	9	0.007	0.928	0.502	0.437	0.459	0.478	9.000	1.454	0.268
Time*Herbivory	9	0.008	1.037	0.412	0.385	0.397	0.488	9.000	0.289	0.289
Time*Productivity*Herbivory	9	0.004	0.564	0.825	0.651	0.707	0.624	9.000	0.805	0.621
Error	180	0.008								
Greenhouse-Geisser Epsilon: 0.3547										
Huynh-Feldt Epsilon : 0.4933										
<i>C. Articulated coralline algae</i>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						
Productivity	1	5.021	68.411	<0.0001						
Herbivory	1	0.317	4.315	0.051						
Productivity*Herbivory	1	0.989	13.482	0.002						
Error	20	1.468								
<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.039	3.437	0.001	0.013	0.004	0.520	9.000	1.229	0.362
Time*Productivity	9	0.098	8.551	<0.0001	<0.0001	<0.0001	0.221	9.000	4.687	0.008
Time*Herbivory	9	0.021	1.853	0.062	0.128	0.098	0.654	9.000	0.705	0.696
Time*Productivity*Herbivory	9	0.039	3.395	0.001	0.013	0.005	0.357	9.000	2.403	0.079

Error	180	0.011								
Greenhouse-Geisser Epsilon: 0.4355										
Huynh-Feldt Epsilon: 0.6361										
<i>D. Ulva spp.</i>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						
Productivity	1	0.479	1.226	0.281						
Herbivory	1	2.273	5.814	0.026						
Productivity*Herbivory	1	3.210	8.214	0.010						
Error	20	0.391								
<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.030	1.535	0.139	0.201	0.176	0.493	9.000	1.369	0.300
Time*Productivity	9	0.099	5.101	<0.0001	0.001	<0.001	0.237	9.000	4.295	0.011
Time*Herbivory	9	0.031	1.604	0.117	0.183	0.156	0.499	9.000	1.336	0.313
Time*Productivity*Herbivory	9	0.090	4.625	<0.0001	0.002	<0.001	0.244	9.000	4.134	0.013
Error	180	0.019								
Greenhouse-Geisser Epsilon: 0.4338										

Huynh-Feldt Epsilon: 0.6330										
<i>E. Crustose algae</i>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						
Productivity	1	0.000	0.000	0.989						
Herbivory	1	2.949	10.605	0.004						
Productivity*Herbivory	1	2.095	7.533	0.012						
Error	20	0.278								
<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.013	0.685	0.722	0.586	0.635	0.360	9.000	2.367	0.083
Time*Productivity	9	0.015	0.769	0.645	0.533	0.573	0.350	9.000	2.479	0.072
Time*Herbivory	9	0.011	0.555	0.832	0.673	0.733	0.417	9.000	1.862	0.156
Time*Productivity*Herbivory	9	0.019	0.959	0.476	0.427	0.447	0.415	9.000	1.881	0.152
Error	180	0.020								
Greenhouse-Geisser Epsilon: 0.3885										
Huynh-Feldt Epsilon: 0.5514										
<i>F. Sessile invertebrates</i>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						

Productivity	1	0.101	9.690	0.005						
Herbivory	1	0.057	5.468	0.030						
Productivity*Herbivory	1	0.001	0.110	0.744						
Error	20	0.010								
<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.006	1.421	0.182	0.232	0.208	0.526	9.000	1.202	0.375
Time*Productivity	9	0.007	1.586	0.122	0.182	0.153	0.391	9.000	2.081	0.118
Time*Herbivory	9	0.002	0.423	0.921	0.802	0.871	0.725	9.000	0.506	0.844
Time*Productivity*Herbivory	9	0.003	0.796	0.621	0.538	0.581	0.543	9.000	1.122	0.416
Error	180	0.004								
Greenhouse-Geisser Epsilon:0.4709										
Huynh-Feldt Epsilon: 0.7029										

TABLE B3. Repeated-measures ANOVAs to test the effect of productivity and herbivory on frond length of algae.

<i>A. Filamentous red algae</i>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						



Productivity	1	0.329	10.440	0.004						
Herbivory	1	0.519	16.501	0.001						
Productivity*Herbivory	1	0.357	11.330	0.003						
Error	20	0.031								
<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.025	2.627	0.007	0.032	0.014	0.312	9	2.943	0.042
Time*Productivity	9	0.030	3.156	0.001	0.013	0.004	0.313	9	2.933	0.043
Time*Herbivory	9	0.015	1.610	0.115	0.170	0.136	0.399	9	2.012	0.129
Time*Productivity*Herbivory	9	0.013	1.409	0.187	0.232	0.205	0.413	9	1.898	0.149
Error	180	0.009								
Greenhouse-Geisser Epsilon: 0.5144										
Huynh-Feldt Epsilon: 0.7888										
<i>B. Filamentous green aglae</i>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						
Productivity	1	0.579	12.813	0.002						

Herbivory	1	0.390	8.628	0.008						
Productivity*Herbivory	1	0.250	5.521	0.029						
Error	20	0.045								
<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.007	0.596	0.800	0.699	0.771	0.581	9	0.961	0.153
Time*Productivity	9	0.004	0.332	0.963	0.888	0.947	0.732	9	0.489	0.856
Time*Herbivory	9	0.009	0.843	0.577	0.519	0.561	0.671	9	0.654	0.735
Time*Productivity*Herbivory	9	0.007	0.623	0.776	0.678	0.748	0.808	9	0.318	0.953
Error	180	0.011								
Greenhouse-Geisser Epsilon: 0.5397										
Huynh-Feldt Epsilon: 0.8407										
<i>C. Articulated coralline algae</i>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						
Productivity	1	1.877	77.866	<0.0001						

Herbivory	1	0.156	6.459	0.019						
Productivity*Herbivory	1	0.521	21.609	<0.0001						
Error	20	0.024								
<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.013	3.199	0.001	0.017	0.006	0.235	9	4.339	0.010
Time*Productivity	9	0.040	10.150	<0.0001	<0.0001	<0.0001	0.064	9	19.550	<0.0001
Time*Herbivory	9	0.006	1.549	0.134	0.196	0.169	0.439	9	1.704	0.192
Time*Productivity*Herbivory	9	0.017	4.441	<0.0001	0.003	<0.0001	0.153	9	7.371	0.001
Error	180	0.004								
Greenhouse-Geisser Epsilon: 0.4478										
Huynh-Feldt Epsilon : 0.6590										
<b><i>D. Ulva spp.</i></b>										
<b>Between Subjects/Univariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>p</b>						
Productivity	1	0.002	0.004	0.952						

Herbivory	1	1.091	2.330	0.143						
Productivity*Herbivory	1	0.126	0.269	0.610						
Error	20	0.468								
<b>Within Subjects/Multivariate</b>	<b>df</b>	<b>MS</b>	<b>F</b>	<b>P</b>	<b>G-G</b>	<b>H-F</b>	<b>Wilks'λ</b>	<b>df</b>	<b>F</b>	<b>p</b>
Time	9	0.037	2.402	0.014	0.064	0.040	0.178	9	6.169	0.002
Time*Productivity	9	0.063	4.111	<0.0001	0.006	0.002	0.065	9	19.222	<0.0001
Time*Herbivory	9	0.038	2.485	0.011	0.057	0.035	0.179	9	6.113	0.002
Time*Productivity*Herbivory	9	0.041	2.679	0.006	0.044	0.024	0.090	9	13.437	<0.0001
Error	180	0.015								
Greenhouse-Geisser Epsilon: 0.3999										
Huynh-Feldt Epsilon: 0.5717										

TABLE B4. ANOVA to test the effect of productivity level, macro-herbivory regime and environmental forcing (different ENSO phases) on (A) the relative abundance of sessile organisms (% cover), (B) algal frond length.

(A) Percent cover

	<i>Ulva</i> spp.				Articulated coralline algae		
Source	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	<i>MS</i>	<i>F</i>	<i>p</i>

Corrected Model	23	0.795	24.429	<0.0001	0.382	25.838	<0.0001
Intercept	1	46.618	1433.32	<0.0001	4.301	291.184	<0.0001
Productivity (P)	2	5.508	169.355	<0.0001	1.952	132.158	<0.0001
Phase (E)	1	0.003	0.101	0.751	0.463	31.319	<0.0001
Herbivory (H)	3	0.345	10.621	<0.0001	0.246	16.642	<0.0001
P*E	2	0.207	6.373	0.002	0.287	19.416	<0.0001
P*H	6	0.526	16.179	<0.0001	0.272	18.417	<0.0001
E*H	3	0.343	10.531	<0.0001	0.117	7.919	<0.0001
P*E*H	6	0.211	6.497	<0.0001	0.087	5.869	<0.0001
Error	240	0.033			0.015		
	$R^2= 0.672$				$R^2= 0.685$		
	<b>Filamentous algae</b>				<b>Crustose algae</b>		
<b>Source</b>	<b><i>df</i></b>	<b><i>MS</i></b>	<b><i>F</i></b>	<b><i>p</i></b>	<b><i>MS</i></b>	<b><i>F</i></b>	<b><i>p</i></b>
Corrected Model	23	0.103	15.808	<0.0001	0.967	38.88	<0.0001
Intercept	1	3.223	495.13	<0.0001	35.53	1428.528	<0.0001
Productivity (P)	2	0.688	105.613	<0.0001	6.743	271.108	<0.0001

Phase (E)	1	0.042	6.404	0.012	0.43	17.3	<0.0001
Herbivory (H)	3	0.031	4.833	0.003	0.451	18.146	<0.0001
P*E	2	0.051	7.843	0.001	0.133	5.344	0.005
P*H	6	0.089	13.632	<0.0001	0.871	35.02	<0.0001
E*H	3	0.013	2.002	0.114	0.018	0.739	0.530
P*E*H	6	0.021	3.201	0.005	0.158	6.361	<0.0001
Error	240	0.007			0.025		
	$R^2 = 0.564$				$R^2 = 0.768$		
	<b>Corticated algae</b>				<b>Sessile invertebrates</b>		
<b>Source</b>	<b><i>df</i></b>	<b><i>MS</i></b>	<b><i>F</i></b>	<b><i>p</i></b>	<b><i>MS</i></b>	<b><i>F</i></b>	<b><i>p</i></b>
Corrected Model	23	0.01	11.149	<0.0001	0.003	7.185	<0.0001
Intercept	1	0.177	203.136	<0.0001	0.071	166.021	<0.0001
Productivity (P)	2	0.02	23.375	<0.0001	0.013	31.408	<0.0001
Phase (E)	1	0.019	21.658	<0.0001	0.007	15.484	<0.0001
Herbivory (H)	3	0.021	23.731	<0.0001	0.006	13.934	<0.0001
P*E	2	0.011	12.117	<0.0001	0.003	6.969	0.001

P*H	6	0.006	7.356	<0.0001	0	1.047	0.396
E*H	3	0.006	6.955	<0.0001	0.002	3.654	0.013
P*E*H	6	0.001	1.666	0.130	0	0.612	0.720
Error	240	0.001			0		
	$R^2 = 0.470$				$R^2 = 0.351$		

## (B) Frond Length

	<i>Ulva spp.</i>				Filamentous green algae		
Source	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Productivity (P)	2	4.037	154.058	<0.0001	0.241	18.149	<0.0001
Phase (E)	1	0.361	13.781	<0.0001	0.168	12.658	<0.0001
Herbivory (H)	3	1.373	52.392	<0.0001	0.071	5.337	0.001
P*E	2	0.251	9.587	<0.0001	0.049	3.675	0.027
P*H	6	0.13	4.97	<0.0001	0.098	7.404	<0.0001
E*H	3	0.117	4.472	0.005	0.004	0.334	0.801
P*E*H	6	0.033	1.273	0.271	0.034	2.525	0.022
Error	217	0.026			0.013		

	$R^2 = 0.696$			$R^2 = 0.317$			
	<b>Filamentous red algae</b>			<b>Articulated corallines</b>			
<b>Source</b>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Productivity (P)	2	0.04	3.301	0.039	1.314	203.501	<0.0001
Phase (E)	1	0.033	2.725	0.100	0.26	40.335	<0.0001
Herbivory (H)	3	0.099	8.157	<0.0001	0.162	25.06	<0.0001
P*E	2	0.013	1.041	0.355	0.162	25.111	<0.0001
P*H	6	0.086	7.139	<0.0001	0.101	15.664	<0.0001
E*H	3	0.018	1.485	0.220	0.032	4.924	0.002
P*E*H	6	0.007	0.544	0.775	0.023	3.538	0.002
Error	217	0.012			0.006		
	$R^2 = 0.214$			$R^2 = 0.769$			

TABLE B5. Kruskal-Wallis test of differences in biomass among different functional groups and total algal biomass (g/m<sup>2</sup>) as a function of productivity and herbivory intensity. Values for each taxon are number of samples (N), median biomass (g/m<sup>2</sup>), and biomass rank.

<b>Herbivory level (H)</b>		<i>Ulva</i> sp.	<b>Filamentous red algae</b>	<b>Filamentous green algae</b>	<b>Corticated algae</b>	<b>Articulated coralline algae</b>	<b>Total biomass</b>
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	(N)	(g/m <sup>2</sup> )	Rank	(g/m <sup>2</sup> )	Rank	(g/m <sup>2</sup> )	Rank	(g/m <sup>2</sup> )	Rank	(g/m <sup>2</sup> )	Rank	(g/m <sup>2</sup> )	Rank
<b>Low Productivity</b>													
H1	10	33.5	1	24.4	1	29.2	1	35.4	1	22.4		32.4	1
H2	10	19.8	2	23.2	2	25.8	2	15	3	20.5		19.7	2
H3	9	14.8	3	17.0	3	15.1	3	15	3	18.5		16.2	3
H4	10	11.4	4	15.1	4	7.2	4	16.6	2	18.5		11.3	4
	$\chi^2$	24.4		5.0		24.6		35.185		3.7		18.8	
	<i>p</i>	<b>&lt;0.0001</b>		0.169		<b>&lt;0.0001</b>		<b>&lt;0.0001</b>		0.3		<b>&lt;0.0001</b>	
<b>Mid Productivity</b>													
H1	8	10.4	4	18		0		17.5		22.8		17.6	
H2	9	16.9	3	18.11		0		19.7		21.2		16.7	
H3	10	27.9	1	21.9		0		21.3		17.0		25.4	
H4	10	18.9	2	17.7		0		21.3		16.0		15.8	
	$\chi^2$	12.2		1.62		0		2.1		2.6		4.9	
	<i>p</i>	<b>0.007</b>		0.655		1		0.6		0.5		0.2	
<b>High</b>													

<b>Productivity</b>													
H1	9	11.4	4	19.98	2	0		22.5		29.2	1	29.1	1
H2	9	12.2	3	19.78	3	0		24.4		25.8	2	25.2	2
H3	9	25.2	2	15.22	4	0		21.3		15.1	3	14.9	3
H4	10	26.4	1	20.9	1	0		13.9		7.2	4	8.0	4
	$\chi^2$	15.7		2.314		0		5.1		24.6		22.5	
	$p$	<b>&lt;0.0001</b>		0.51		1		0.2		<b>&lt;0.0001</b>		<b>&lt;0.0001</b>	

[\[Back to M084-014\]](#)