Supplement of Biogeosciences, 15, 6167–6183, 2018
https://doi.org/10.5194/bg-15-6167-2018-supplement

Biogeosciences Open Access EGU

Supplement of

The ability of macroalgae to mitigate the negative effects of ocean acidification on four species of North Atlantic bivalve

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Tables S1. Values of mean pH (total scale), temperature (°C), salinity (g kg^{-1}), and dissolved oxygen (mg L^{-1}), and final pCO_2 (µatm), total alkalinity (µmol $kgSW^{-1}$), total DIC (µmol $kgSW^{-1}$), HCO_3^- (µmol $kgSW^{-1}$), CO_3^{2-} (µmol $kgSW^{-1}$), OH^- (µmol $kgSW^{-1}$), $\Omega_{calcite}$, $\Omega_{aragonite}$, and final microalgal cell counts of *Isochrysis galbana* and *Chaetoceros muelleri* (cells mL^{-1}) for June through November experiments (n=4 for all treatments). Asterisks indicate parameters that were directly measured, and not calculated. Data Values represent means ± standard deviation.

Mercenaria mercenaria – smaller cohorts

Parameter	Control	*Ulva*	CO_2	CO_2/*Ulva*
pH*	8.11±0.04	8.13±0.04	7.47±0.03	7.49±0.03
Temperature*	20.9±0.5	20.9±0.5	20.9±0.4	20.9±0.4
Dissolved oxygen*	9.41±0.13	9.29±0.15	9.26±0.09	9.13±0.11
Salinity*	30.0±0.6	30.0±0.6	30.0±0.6	30.0±0.6
pCO_2	309±27	290±33	1580±112	1513±99
Total alkalinity	2068±23	2066±19	2023±9	2019±7
Total DIC*	1815±200	1790±197	2004±220	1992±219
HCO_3^-	1628±15	1598±18	1905±10	1894±10
CO_3^{2-}	180±14	183±19	48±4	49±4
OH^-	4.40±0.39	4.75±0.32	1.17±0.09	1.25±0.07
$\Omega_{calcite}$	4.40±0.39	4.75±0.32	1.17±0.09	1.25±0.07
$\Omega_{aragonite}$	2.83±0.25	3.06±0.21	0.76±0.06	0.80±0.05
Microalgae cells*	N/A	N/A	N/A	N/A

Mercenaria mercenaria – larger cohorts

Parameter	Control	*Ulva*	CO_2	CO_2/*Ulva*
pH*	7.91±0.07	7.95±0.08	7.34±0.02	7.36±0.02
Temperature*	21.1±0.5	21.1±0.5	21.1±0.5	21.1±0.5
Dissolved oxygen*	9.06±0.15	9.07±0.14	9.21±0.17	8.95±0.09
Salinity*	30.0±0.6	30.0±0.6	30.0±0.6	30.0±0.6
pCO_2	435±86	338±74	1541±73	1634±68
Total alkalinity	1663±24	1450±8	1436±3	1601±4
Total DIC*	1527±168	1293±142	1444±159	1606±177
HCO_3^-	1415±12	1192±12	1369±1	1524±1
CO_3^{2-}	98±15	90±14	25±1	29±1
OH^-	3.09±0.46	3.86±0.23	0.87±0.05	0.90±0.07
$\Omega_{calcite}$	2.34±0.34	2.43±0.12	0.62±0.02	0.73±0.03
$\Omega_{aragonite}$	1.50±0.22	1.57±0.08	0.40±0.01	0.47±0.02
Microalgae cells*	112500±38622	82500±15000	85000±12910	77500±5000

Crassostrea virginica – smaller cohorts

Parameter	Control	*Ulva*	CO_2	CO_2/*Ulva*
pH*	8.09±0.05	8.21±0.11	7.44±0.03	7.46±0.05
Temperature*	21.6±0.6	21.6±0.6	21.6±0.7	21.6±0.6
Dissolved oxygen*	9.23±0.11	8.97±0.08	9.13±0.09	9.02±0.10
Salinity*	30.0±0.6	30.0±0.6	30.0±0.6	30.0±0.6
pCO_2	287±37	210±55	1649±120	1513±158
Total alkalinity	1830±22	1832±68	1971±8	1895±13
Total DIC*	1600±176	1541±170	1957±215	1875±206
HCO_3^-	1437±13	1343±44	1860±1	1782±1
CO_3^{2-}	154±14	192±45	45±3	45±5
OH^-	5.16±0.51	6.93±1.99	1.15±0.09	1.21±0.18
$\Omega_{calcite}$	3.84±0.35	4.78±1.13	1.11±0.07	1.12±0.13
$\Omega_{aragonite}$	2.47±0.23	3.08±0.73	0.72±0.05	0.72±0.08
Microalgae cells*	112500±18930	120000±31623	120000±23094	137500±22174

Crassostrea virginica – larger cohorts

Parameter	Control	*Ulva*	CO_2	CO_2/*Ulva*
pH*	7.87±0.05	7.92±0.06	7.30±0.03	7.31±0.03
Temperature*	20.8±0.6	20.8±0.5	20.9±0.5	20.9±0.5
Dissolved oxygen*	8.97±0.17	8.56±0.74	9.02±0.16	8.97±0.16
Salinity*	29.0±0.6	29.1±0.6	28.9±0.6	29.0±0.6
pCO_2	398±49	363±55	1945±150	1825±144
Total alkalinity	1374±15	1459±20	1647±3	1576±7
Total DIC*	1265±139	1327±146	1673±184	1592±175
HCO_3^-	1180±7	1230±10	1584±2	1507±2
CO_3^{2-}	71±8	85±11	25±1	26±2
OH^-	2.79±0.35	3.20±0.47	0.74±0.07	0.79±0.06
$\Omega_{calcite}$	1.78±0.21	2.13±0.29	0.63±0.02	0.64±0.05
$\Omega_{aragonite}$	1.14±0.13	1.37±0.18	0.41±0.02	0.42±0.03
Microalgae cells*	87500±15000	90000±10000	82500±12583	90000±11547

Argopecten irradians – smaller cohorts

Parameter	Control	*Ulva*	CO_2	CO_2/*Ulva*
pH*	7.94±0.03	8.01±0.07	7.35±0.03	7.37±0.04
Temperature*	21.8±0.9	21.8±0.9	21.8±0.9	21.7±0.9
Dissolved oxygen*	9.16±0.16	9.00±0.16	9.00±0.16	9.01±0.16
Salinity*	30.0±0.6	30.0±0.6	30.0±0.6	30.0±0.6
pCO_2	422±28	368±62	1898±137	1938±196
Total alkalinity	1778±12	1839±36	1816±7	1947±11
Total DIC*	1615±178	1644±181	1824±201	1951±215
HCO_3^-	1489±7	1499±21	1730±2	1852±2
CO_3^{2-}	112±8	133±23	34±2	38±4
OH^-	3.58±0.31	4.33±0.92	0.93±0.07	0.98±0.09
$\Omega_{calcite}$	2.80±0.19	3.32±0.57	0.84±0.05	0.94±0.09
$\Omega_{aragonite}$	1.80±0.12	2.14±0.37	0.54±0.03	0.61±0.06
Microalgae cells*	77500±17078	85000±12910	75000±5774	80000±11547

Argopecten irradians – larger cohorts

Parameter	Control	*Ulva*	CO_2	CO_2/*Ulva*
pH*	7.96±0.02	7.99±0.03	7.34±0.04	7.36±0.04
Temperature*	21.2±0.6	21.1±0.5	21.3±0.5	21.3±0.6
Dissolved oxygen*	8.86±0.18	9.06±0.32	8.96±0.21	9.20±0.17
Salinity*	30.4±0.6	30.4±0.6	30.5±0.6	30.4±0.6
pCO_2	405±18	396±33	2018±171	1962±159
Total alkalinity	1803±7	1888±14	1899±10	1919±9
Total DIC*	1633±180	1702±187	1911±210	1926±212
HCO_3^-	1503±4	1560±7	1812±2	1828±2
CO_3^{2-}	117±5	129±8	35±3	36±3
OH^-	3.65±0.21	3.85±0.28	0.91±0.08	0.95±0.08
$\Omega_{calcite}$	2.90±0.11	3.19±0.21	0.85±0.07	0.89±0.07
$\Omega_{aragonite}$	1.87±0.07	2.06±0.13	0.55±0.05	0.58±0.04
Microalgae cells*	92500±20616	97500±22174	80000±14142	90000±14142

Mytilus edulis

Parameter	Control	*Ulva*	CO_2	CO_2/*Ulva*
pH*	7.98±0.11	8.00±0.10	7.36±0.07	7.37±0.07
Temperature*	21.7±0.9	21.7±0.9	21.7±1.0	21.7±1.0
Dissolved oxygen*	9.12±0.17	9.08±0.14	9.05±0.16	9.09±0.13
Salinity*	31.0±0.6	31.0±0.6	31.0±0.6	31.0±0.6
pCO_2	357±85	361±78	1648±226	1636±223
Total alkalinity	1629±32	1765±51	1617±10	1643±18
Total DIC*	1472±162	1572±173	1624±179	1642±181
HCO_3^-	1345±29	1432±30	1540±2	1557±2
CO_3^{2-}	103±19	129±32	29±3	33±6
OH^-	3.34±0.33	4.40±1.44	0.90±0.13	1.02±0.26
$\Omega_{calcite}$	2.55±0.47	3.19±0.81	0.72±0.08	0.81±0.16
$\Omega_{aragonite}$	1.65±0.31	2.06±0.53	0.47±0.05	0.53±0.11
Microalgae cells*	107500±12583	107500±9574	100000±8165	95000±12910

Table S2. Two-way analyses of variance for $\Omega_{calcite}$ for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results. Shapiro-Wilk test used to test for normality.

Species (size class)	Source of variation	DF	SS	MS	F	P	P (Normality)	P (Equal variance)
Mercenaria mercenaria (small)	CO_2	1	3.322	3.322	3275.022	<0.001*	0.995	0.986
	Ulva	1	0.0117	0.0117	11.492	0.002*		
	CO_2 x *Ulva*	1	4.05E-06	4.05E-06	0.004	0.950		
	Residual	36	0.0365	0.00101				
	Total	39	3.39	0.0869				
Mercenaria mercenaria (large)	CO_2	1	1.972	1.972	1567.481	<0.001*	0.249	0.365
	Ulva	1	0.0144	0.0144	11.478	0.002*		
	CO_2 x *Ulva*	1	0.00034	0.00034	0.27	0.607		
	Residual	26	0.0327	0.00126				
	Total	29	2.022	0.0697				
Crassostrea virginica (small)	CO_2	1	2.309	2.309	1251.139	<0.001*	0.615	0.536
	Ulva	1	0.0104	0.0104	5.644	0.025*		
	CO_2 x *Ulva*	1	0.00617	0.00617	3.345	0.079		
	Residual	26	0.048	0.00185				
	Total	29	2.4	0.0828				
Crassostrea virginica (large)	CO_2	1	2.186	2.186	2322.463	<0.001*	0.434	0.075
	Ulva	1	0.0338	0.0338	35.941	<0.001*		
	CO_2 x *Ulva*	1	0.0261	0.0261	27.726	<0.001*		
	Residual	32	0.0301	0.000941				
	Total	35	2.286	0.0653				
Argopecten irradians (small)	CO_2	1	2.266	2.266	6148.326	<0.001*	0.914	0.232
	Ulva	1	0.00723	0.00723	19.608	<0.001*		
	CO_2 x *Ulva*	1	0.0106	0.0106	28.639	<0.001*		
	Residual	27	0.00995	0.000368				
	Total	30	2.321	0.0774				
Argopecten irradians (large)	CO_2	1	3.302	3.302	4992.139	<0.001*	0.557	0.065
	Ulva	1	0.0111	0.0111	16.77	<0.001*		
	CO_2 x *Ulva*	1	0.000422	0.000422	0.638	0.429		
	Residual	40	0.0265	0.000661				
	Total	43	3.329	0.0774				
Mytilus edulis	CO_2	1	2.086	2.086	677.291	<0.001*	0.052	0.299
	Ulva	1	0.0199	0.0199	6.465	0.017*		
	CO_2 x *Ulva*	1	0.000288	0.000288	0.0935	0.762		
	Residual	27	0.0831	0.00308				
	Total	30	2.169	0.0723				

Table S3. Two-way analyses of variance for $\Omega_{aragonite}$ for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results. Shapiro-Wilk test used to test for normality.

Species (size class)	Source of variation	DF	SS	MS	F	P	P (Normality)	P (Equal variance)
Mercenaria mercenaria (small)	CO_2	1	3.409	3.409	3072.496	<0.001*	0.998	0.925
	Ulva	1	0.00899	0.00899	8.105	0.007*		
	CO_2 x *Ulva*	1	0.000191	0.000191	0.172	0.681		
	Residual	38	0.0422	0.00111				
	Total	41	3.524	0.086				
Mercenaria mercenaria (large)	CO_2	1	2.265	2.265	5836.754	<0.001*	0.685	0.301
	Ulva	1	0.00766	0.00766	19.74	<0.001*		
	CO_2 x *Ulva*	1	0.0111	0.0111	28.621	<0.001*		
	Residual	27	0.0105	0.000388				
	Total	30	2.322	0.0774				
Crassostrea virginica (small)	CO_2	1	2.301	2.301	1259.748	<0.001*	0.634	0.525
	Ulva	1	0.0104	0.0104	5.7	0.025*		
	CO_2 x *Ulva*	1	0.00603	0.00603	3.303	0.081		
	Residual	26	0.0475	0.00183				
	Total	29	2.391	0.0825				
Crassostrea virginica (large)	CO_2	1	2.134	2.134	2241.492	<0.001*	0.342	0.246
	Ulva	1	0.0356	0.0356	37.402	<0.001*		
	CO_2 x *Ulva*	1	0.0247	0.0247	25.982	<0.001*		
	Residual	32	0.0305	0.000952				
	Total	35	2.243	0.0641				
Argopecten irradians (small)	CO_2	1	1.973	1.973	1503.447	<0.001*	0.305	0.318
	Ulva	1	0.0143	0.0143	10.876	0.003*		
	CO_2 x *Ulva*	1	0.000357	0.000357	0.272	0.606		
	Residual	26	0.0341	0.00131				
	Total	29	2.024	0.0698				
Argopecten irradians (large)	CO_2	1	3.302	3.302	4980.646	<0.001*	0.305	0.097
	Ulva	1	0.0113	0.0113	17.086	<0.001*		
	CO_2 x *Ulva*	1	0.000365	0.000365	0.551	0.462		
	Residual	40	0.0265	0.000663				
	Total	43	3.33	0.0774				
Mytilus edulis	CO_2	1	2.078	2.078	651.8	<0.001*	0.054	0.237
	Ulva	1	0.0195	0.0195	6.105	0.020*		
	CO_2 x *Ulva*	1	0.000359	0.000359	0.113	0.740		
	Residual	27	0.0861	0.00319				
	Total	30	2.165	0.0722				

Table S4. Two-way analyses of variance for shell length-based growth for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results. Shapiro-Wilk test used to test for normality.

Species (size class)	Source of variation	DF	SS	MS	F	P	P (Normality)	P (Equal variance)
Mercenaria mercenaria (small)	CO_2	1	0.116	0.116	79.946	<0.001*	0.960	0.078
	Ulva	1	0.0169	0.0169	11.608	0.006*		
	CO_2 x *Ulva*	1	0.0053	0.0053	3.644	0.083		
	Residual	11	0.016	0.00145				
	Total	14	0.145	0.0103				
Mercenaria mercenaria (large)	CO_2	1	0.0494	0.0494	9.802	0.010*	0.497	0.717
	Ulva	1	0.0712	0.0712	14.113	0.003*		
	CO_2 x *Ulva*	1	0.0205	0.0205	4.068	0.069		
	Residual	11	0.0555	0.00504				
	Total	14	0.179	0.0128				
Crassostrea virginica (small)	CO_2	1	0.154	0.154	9.565	0.011*	0.797	0.228
	Ulva	1	0.0891	0.0891	5.547	0.040*		
	CO_2 x *Ulva*	1	0.00575	0.00575	0.358	0.563		
	Residual	10	0.161	0.0161				
	Total	13	0.404	0.0311				
Crassostrea virginica (large)	CO_2	1	0.645	0.645	35.401	0.001*	0.297	0.139
	Ulva	1	0.315	0.315	17.295	0.006*		
	CO_2 x *Ulva*	1	0.165	0.165	9.041	0.024*		
	Residual	6	0.109	0.0182				
	Total	9	1.086	0.121				
Argopecten irradians (small)	CO_2	1	0.0456	0.0456	25.899	<0.001*	0.124	0.123
	Ulva	1	0.0194	0.0194	11.026	0.007*		
	CO_2 x *Ulva*	1	0.00879	0.00879	4.989	0.047*		
	Residual	11	0.0194	0.00176				
	Total	14	0.0849	0.00607				
Argopecten irradians (large)	CO_2	1	0.0376	0.0376	37.798	<0.001*	0.160	0.842
	Ulva	1	0.01	0.01	10.051	0.016*		
	CO_2 x *Ulva*	1	0.00131	0.00131	1.321	0.288		
	Residual	7	0.00697	0.000995				
	Total	10	0.0603	0.00603				
Mytilus edulis	CO_2	1	0.0133	0.0133	2.442	0.149	0.881	0.287
	Ulva	1	0.0286	0.0286	5.25	0.045*		
	CO_2 x *Ulva*	1	0.00136	0.00136	0.25	0.628		
	Residual	10	0.0545	0.00545				
	Total	13	0.0993	0.00764				

Table S5. Two-way analyses of variance for shell weight-based growth for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results. Shapiro-Wilk test used to test for normality.

Species (size class)	Source of Variation	DF	SS	MS	F	P	P (Normality)	P (Equal variance)
Mercenaria mercenaria (small)	CO_2	1	0.221	0.221	31.805	<0.001*	0.652	0.081
	Ulva	1	0.0637	0.0637	9.173	0.011*		
	CO_2 x *Ulva*	1	0.00237	0.00237	0.341	0.571		
	Residual	11	0.0764	0.00694				
	Total	14	0.344	0.0246				
Mercenaria mercenaria (large)	CO_2	1	0.0277	0.0277	11.367	0.010*	0.115	0.059
	Ulva	1	0.0326	0.0326	13.37	0.006*		
	CO_2 x *Ulva*	1	0.0023	0.0023	0.944	0.360		
	Residual	8	0.0195	0.00244				
	Total	11	0.0709	0.00645				
Crassostrea virginica (small)	CO_2	1	0.188	0.188	9.145	0.012*	0.819	0.706
	Ulva	1	9.82E-05	9.82E-05	0.00479	0.946		
	CO_2 x *Ulva*	1	0.00471	0.00471	0.23	0.641		
	Residual	11	0.226	0.0205				
	Total	14	0.425	0.0303				
Crassostrea virginica (large)	CO_2	1	0.0119	0.0119	0.784	0.405	0.965	0.259
	Ulva	1	0.0259	0.0259	1.701	0.233		
	CO_2 x *Ulva*	1	0.0241	0.0241	1.586	0.248		
	Residual	7	0.106	0.0152				
	Total	10	0.172	0.0172				
Argopecten irradians (small)	CO_2	1	0.0488	0.0488	5.509	0.041*	0.408	0.210
	Ulva	1	0.0021	0.0021	0.237	0.637		
	CO_2 x *Ulva*	1	0.00496	0.00496	0.56	0.471		
	Residual	10	0.0885	0.00885				
	Total	13	0.144	0.011				
Argopecten irradians (large)	CO_2	1	0.00429	0.00429	0.395	0.553	0.683	0.219
	Ulva	1	0.00934	0.00934	0.859	0.390		
	CO_2 x *Ulva*	1	4.59E-05	4.59E-05	0.00422	0.950		
	Residual	6	0.0652	0.0109				
	Total	9	0.0821	0.00912				
Mytilus edulis	CO_2	1	0.0121	0.0121	0.644	0.439	0.095	0.843
	Ulva	1	0.129	0.129	6.87	0.024*		
	CO_2 x *Ulva*	1	7.96E-06	7.96E-06	0.000423	0.984		
	Residual	11	0.207	0.0188				
	Total	14	0.355	0.0254				

Table S6. Two-way analyses of variance for tissue weight-based growth for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results. Shapiro-Wilk test used to test for normality.

Species (size class)	Source of Variation	DF	SS	MS	F	P	P (Normality)	P (Equal variance)
Mercenaria mercenaria (small)	CO_2	1	0.0196	0.0196	6.54	0.038*	0.189	0.545
	Ulva	1	0.04	0.04	13.369	0.008*		
	CO_2 x *Ulva*	1	0.00159	0.00159	0.53	0.490		
	Residual	7	0.021	0.003				
	Total	10	0.0751	0.00751				
Mercenaria mercenaria (large)	CO_2	1	0.0259	0.0259	32.136	<0.001*	0.301	0.677
	Ulva	1	0.00963	0.00963	11.928	0.009*		
	CO_2 x *Ulva*	1	0.000263	0.000263	0.326	0.584		
	Residual	8	0.00646	0.000807				
	Total	11	0.0423	0.00384				
Crassostrea virginica (small)	CO_2	1	0.261	0.261	12.287	0.006*	0.461	0.591
	Ulva	1	0.0234	0.0234	1.1	0.319		
	CO_2 x *Ulva*	1	0.00211	0.00211	0.0993	0.759		
	Residual	10	0.212	0.0212				
	Total	13	0.482	0.0371				
Crassostrea virginica (large)	CO_2	1	0.11	0.11	2.498	0.189	0.253	0.439
	Ulva	1	0.0711	0.0711	1.615	0.273		
	CO_2 x *Ulva*	1	0.552	0.552	12.539	0.024*		
	Residual	4	0.176	0.044				
	Total	7	0.745	0.106				
Argopecten irradians (small)	CO_2	1	0.1	0.1	6.952	0.023*	0.208	0.120
	Ulva	1	0.0191	0.0191	1.325	0.274		
	CO_2 x *Ulva*	1	6.81E-07	6.81E-07	4.73E-05	0.995		
	Residual	11	0.159	0.0144				
	Total	14	0.285	0.0204				
Argopecten irradians (large)	CO_2	1	0.542	0.542	10.06	0.019*	0.304	0.292
	Ulva	1	0.414	0.414	7.682	0.032*		
	CO_2 x *Ulva*	1	0.000541	0.000541	0.01	0.923		
	Residual	6	0.323	0.0538				
	Total	9	1.29	0.143				
Mytilus edulis	CO_2	1	0.0142	0.0142	1.77	0.210	0.855	0.756
	Ulva	1	0.0403	0.0403	5.015	0.047*		
	CO_2 x *Ulva*	1	0.00105	0.00105	0.13	0.725		
	Residual	11	0.0883	0.00803				
	Total	14	0.148	0.0106				

Table S7. Tukey Honest Significant Difference tests for shell length-based growth for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results.

Species (cohort)	Treatment	Difference	Lower	Upper	P-value
Mercenaria mercenaria (small)	CO_2 vs. Control	-0.032	-0.046	-0.019	<0.001*
	Ulva vs. Control	0.006	-0.007	0.018	0.554
	CO_2/*Ulva* vs. Control	-0.018	-0.031	-0.006	0.005*
	Ulva vs. CO_2	0.038	0.024	0.052	<0.001*
	CO_2/*Ulva* vs. CO_2	0.014	0.000	0.028	0.044*
	CO_2/*Ulva* vs. *Ulva*	-0.024	-0.037	-0.011	0.001*
Mercenaria mercenaria (large)	CO_2 vs. Control	-0.005	-0.022	0.012	0.796
	Ulva vs. Control	0.030	0.012	0.048	0.002*
	CO_2/*Ulva* vs. Control	0.002	-0.015	0.019	0.984
	Ulva vs. CO_2	0.035	0.017	0.053	0.001*
	CO_2/*Ulva* vs. CO_2	0.007	-0.010	0.024	0.598
	CO_2/*Ulva* vs. *Ulva*	-0.028	-0.046	-0.010	0.003*
Crassostrea virginica (small)	CO_2 vs. Control	-0.027	-0.071	0.017	0.289
	Ulva vs. Control	0.049	0.002	0.096	0.040*
	CO_2/*Ulva* vs. Control	-0.012	-0.059	0.035	0.861
	Ulva vs. CO_2	0.076	0.029	0.123	0.003*
	CO_2/*Ulva* vs. CO_2	0.015	-0.032	0.062	0.767
	CO_2/*Ulva* vs. *Ulva*	-0.061	-0.111	-0.011	0.018*
Crassostrea virginica (large)	CO_2 vs. Control	-0.138	-0.222	-0.055	0.004*
	Ulva vs. Control	0.037	-0.056	0.130	0.587
	CO_2/*Ulva* vs. Control	-0.046	-0.130	0.037	0.333
	Ulva vs. CO_2	0.175	0.082	0.268	0.002*
	CO_2/*Ulva* vs. CO_2	0.092	0.009	0.176	0.032*
	CO_2/*Ulva* vs. *Ulva*	-0.083	-0.176	0.010	0.080
Argopecten irradians (small)	CO_2 vs. Control	-0.033	-0.052	-0.015	0.001*
	Ulva vs. Control	0.006	-0.012	0.025	0.733
	CO_2/*Ulva* vs. Control	-0.009	-0.028	0.009	0.455
	Ulva vs. CO_2	0.040	0.021	0.058	<0.001*
	CO_2/*Ulva* vs. CO_2	0.024	0.005	0.042	0.011*
	CO_2/*Ulva* vs. *Ulva*	-0.016	-0.034	0.003	0.100
Argopecten irradians (large)	CO_2 vs. Control	-0.027	-0.053	-0.001	0.043*
	Ulva vs. Control	0.029	0.003	0.055	0.032*
	CO_2/*Ulva* vs. Control	-0.017	-0.046	0.012	0.300
	Ulva vs. CO_2	0.056	0.030	0.082	0.001*
	CO_2/*Ulva* vs. CO_2	0.010	-0.019	0.039	0.681
	CO_2/*Ulva* vs. *Ulva*	-0.046	-0.075	-0.017	0.005*
Mytilus edulis	CO_2 vs. Control	0.014	-0.012	0.041	0.398
	Ulva vs. Control	0.018	-0.011	0.047	0.275
	CO_2/*Ulva* vs. Control	0.026	-0.002	0.055	0.072
	Ulva vs. CO_2	0.004	-0.025	0.032	0.976
	CO_2/*Ulva* vs. CO_2	0.012	-0.016	0.041	0.580
	CO_2/*Ulva* vs. *Ulva*	0.008	-0.022	0.039	0.835

Table S8. Tukey Honest Significant Difference tests for shell weight-based growth for tissue weight-based growth for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results.

Species (cohort)	Treatment	Difference	Lower	Upper	P-value
Mercenaria mercenaria (small)	CO_2 vs. Control	-0.058	-0.117	0.000	0.051
	Ulva vs. Control	0.038	-0.016	0.092	0.206
	CO_2/*Ulva* vs. Control	-0.026	-0.080	0.028	0.494
	Ulva vs. CO_2	0.097	0.038	0.155	0.002*
	CO_2/*Ulva* vs. CO_2	0.032	-0.026	0.091	0.392
	CO_2/*Ulva* vs. *Ulva*	-0.064	-0.119	-0.010	0.019*
Mercenaria mercenaria (large)	CO_2 vs. Control	-0.138	-0.430	0.154	0.488
	Ulva vs. Control	0.407	0.115	0.699	0.008*
	CO_2/*Ulva* vs. Control	0.021	-0.252	0.294	0.995
	Ulva vs. CO_2	0.545	0.253	0.837	0.001*
	CO_2/*Ulva* vs. CO_2	0.159	-0.114	0.432	0.324
	CO_2/*Ulva* vs. *Ulva*	-0.385	-0.658	-0.112	0.008*
Crassostrea virginica (small)	CO_2 vs. Control	-0.106	-0.239	0.026	0.132
	Ulva vs. Control	-0.015	-0.148	0.117	0.985
	CO_2/*Ulva* vs. Control	-0.102	-0.245	0.042	0.202
	Ulva vs. CO_2	0.091	-0.042	0.223	0.225
	CO_2/*Ulva* vs. CO_2	0.005	-0.138	0.148	1.000
	CO_2/*Ulva* vs. *Ulva*	-0.086	-0.229	0.057	0.319
Crassostrea virginica (large)	CO_2 vs. Control	-0.200	-13.950	13.551	1.000
	Ulva vs. Control	-6.376	-20.127	7.375	0.468
	CO_2/*Ulva* vs. Control	-0.869	-14.619	12.882	0.996
	Ulva vs. CO_2	-6.176	-18.475	6.123	0.407
	CO_2/*Ulva* vs. CO_2	-0.669	-12.968	11.630	0.998
	CO_2/*Ulva* vs. *Ulva*	5.507	-6.792	17.806	0.494
Argopecten irradians (small)	CO_2 vs. Control	-0.210	-0.444	0.024	0.085
	Ulva vs. Control	-0.004	-0.239	0.230	1.000
	CO_2/*Ulva* vs. Control	-0.140	-0.374	0.094	0.331
	Ulva vs. CO_2	0.205	-0.029	0.440	0.093
	CO_2/*Ulva* vs. CO_2	0.070	-0.164	0.304	0.812
	CO_2/*Ulva* vs. *Ulva*	-0.136	-0.370	0.099	0.357
Argopecten irradians (large)	CO_2 vs. Control	-0.721	-6.911	5.468	0.976
	Ulva vs. Control	1.257	-4.933	7.446	0.892
	CO_2/*Ulva* vs. Control	0.581	-6.199	7.361	0.990
	Ulva vs. CO_2	1.978	-3.558	7.514	0.629
	CO_2/*Ulva* vs. CO_2	1.302	-4.887	7.491	0.882
	CO_2/*Ulva* vs. *Ulva*	-0.676	-6.865	5.513	0.980
Mytilus edulis	CO_2 vs. Control	0.037	-0.115	0.188	0.890
	Ulva vs. Control	0.067	-0.084	0.219	0.569
	CO_2/*Ulva* vs. Control	0.137	-0.015	0.289	0.082
	Ulva vs. CO_2	0.031	-0.121	0.183	0.929
	CO_2/*Ulva* vs. CO_2	0.101	-0.051	0.252	0.254
	CO_2/*Ulva* vs. *Ulva*	0.070	-0.082	0.221	0.545

Table S9. Tukey Honest Significant Difference tests for tissue weight-based growth for tissue weight-based growth for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results.

Species (cohort)	Treatment	Difference	Lower	Upper	P-value
Mercenaria mercenaria (small)	CO_2 vs. Control	-0.006	-0.016	0.003	0.233
	Ulva vs. Control	0.006	-0.003	0.016	0.232
	CO_2/*Ulva* vs. Control	0.001	-0.009	0.010	0.997
	Ulva vs. CO_2	0.013	0.003	0.023	0.011*
	CO_2/*Ulva* vs. CO_2	0.007	-0.002	0.016	0.143
	CO_2/*Ulva* vs. *Ulva*	-0.006	-0.015	0.003	0.252
Mercenaria mercenaria (large)	CO_2 vs. Control	-0.016	-0.033	0.001	0.070
	Ulva vs. Control	0.015	-0.002	0.031	0.098
	CO_2/*Ulva* vs. Control	-0.004	-0.020	0.012	0.851
	Ulva vs. CO_2	0.030	0.013	0.047	0.002*
	CO_2/*Ulva* vs. CO_2	0.012	-0.004	0.027	0.172
	CO_2/*Ulva* vs. *Ulva*	-0.019	-0.034	-0.003	0.022*
Crassostrea virginica (small)	CO_2 vs. Control	-0.023	-0.052	0.006	0.127
	Ulva vs. Control	0.007	-0.022	0.036	0.887
	CO_2/*Ulva* vs. Control	-0.015	-0.042	0.011	0.343
	Ulva vs. CO_2	0.030	-0.001	0.061	0.057
	CO_2/*Ulva* vs. CO_2	0.008	-0.021	0.037	0.840
	CO_2/*Ulva* vs. *Ulva*	-0.022	-0.051	0.007	0.150
Crassostrea virginica (large)	CO_2 vs. Control	-4.693	-11.124	1.737	0.141
	Ulva vs. Control	-2.992	-8.862	2.878	0.341
	CO_2/*Ulva* vs. Control	-0.698	-7.129	5.732	0.976
	Ulva vs. CO_2	1.701	-4.169	7.572	0.721
	CO_2/*Ulva* vs. CO_2	3.995	-2.435	10.425	0.219
	CO_2/*Ulva* vs. *Ulva*	2.294	-3.577	8.164	0.529
Argopecten irradians (small)	CO_2 vs. Control	-0.030	-0.076	0.015	0.245
	Ulva vs. Control	-0.016	-0.058	0.027	0.688
	CO_2/*Ulva* vs. Control	-0.044	-0.087	-0.002	0.040*
	Ulva vs. CO_2	0.015	-0.031	0.061	0.769
	CO_2/*Ulva* vs. CO_2	-0.014	-0.060	0.032	0.801
	CO_2/*Ulva* vs. *Ulva*	-0.029	-0.071	0.014	0.236
Argopecten irradians (large)	CO_2 vs. Control	-0.324	-1.246	0.599	0.546
	Ulva vs. Control	0.816	-0.106	1.738	0.073
	CO_2/*Ulva* vs. Control	0.122	-0.800	1.044	0.945
	Ulva vs. CO_2	1.139	0.217	2.061	0.025*
	CO_2/*Ulva* vs. CO_2	0.446	-0.476	1.368	0.332
	CO_2/*Ulva* vs. *Ulva*	-0.694	-1.616	0.229	0.118
Mytilus edulis	CO_2 vs. Control	0.006	-0.021	0.032	0.922
	Ulva vs. Control	0.011	-0.018	0.040	0.692
	CO_2/*Ulva* vs. Control	0.024	-0.003	0.051	0.080
	Ulva vs. CO_2	0.005	-0.024	0.034	0.949
	CO_2/*Ulva* vs. CO_2	0.019	-0.008	0.045	0.212
	CO_2/*Ulva* vs. *Ulva*	0.014	-0.015	0.042	0.517

Table S10. Linear regressions between $\Omega_{aragonite}$ and shell length-, tissue weight-, and shell weight-based growth of smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). **Bold** results represent strong, significant correlations ($R^2 > 0.200$ and $p<0.05$).

Species (size class)	Shell length		Tissue weight		Shell weight	
	R-squared	P-value	R-squared	P-value	R-squared	P-value
Mercenaria mercenaria (small)	**0.790**	**<0.001**	0.302	0.052	**0.530**	**0.001**
Mercenaria mercenaria (large)	**0.452**	**0.006**	**0.444**	**0.013**	0.280	0.063
Crassostrea virginica (small)	**0.259**	**0.044**	**0.527**	**0.003**	**0.391**	**0.013**
Crassostrea virginica (large)	**0.661**	**0.002**	0.022	0.705	0.202	0.165
Argopecten irradians (small)	**0.558**	**0.001**	**0.358**	**0.018**	**0.467**	**0.004**
Argopecten irradians (large)	**0.739**	**0.001**	0.401	0.092	0.118	0.330
Mytilus edulis	0.108	0.252	0.102	0.247	0.070	0.322

Table S11. Linear regressions between $\Omega_{calcite}$ and shell length-, tissue weight-, and shell weight-based growth of smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). **Bold** results represent strong, significant correlations ($R^2 > 0.200$ and $p<0.05$).

Species (size class)	Shell length		Tissue weight		Shell weight	
	R-squared	P-value	R-squared	P-value	R-squared	P-value
Mercenaria mercenaria (small)	**0.790**	**<0.001**	0.303	0.051	**0.531**	**0.002**
Mercenaria mercenaria (large)	**0.449**	**0.006**	**0.444**	**0.013**	0.279	0.063
Crassostrea virginica (small)	**0.257**	**0.045**	**0.527**	**0.003**	**0.390**	**0.013**
Crassostrea virginica (large)	**0.660**	**0.002**	0.021	0.708	0.204	0.163
Argopecten irradians (small)	**0.557**	**0.001**	**0.359**	**0.018**	**0.466**	**0.004**
Argopecten irradians (large)	**0.740**	**0.001**	0.402	0.091	0.118	0.331
Mytilus edulis	0.108	0.252	0.101	0.247	0.070	0.321

Table S12. One-way analysis of variance for growth rates of *Ulva* exposed to ambient and elevated CO_2 conditions for June through November experiments. Shapiro-Wilk test used to test for normality.

Source of Variation	DF	SS	MS	F	P	P (Normality)	P (Equal variance)
Between Groups	1	0.151	0.151	4.174	0.043	0.650	0.749
Residual	110	3.987	0.0362				
Total	111	4.139					

Table S13. Two-way analyses of variance for final cell concentrations of *Isochrysis galbana* and *Chaetoceros muelleri* fed to smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results. Shapiro-Wilk test used to test for normality.

Species (size class)	Source of Variation	DF	SS	MS	F	P	P (Normality)	P (Equal variance)
Mercenaria mercenaria (large)	CO_2	1	1.06E+09	1.06E+09	2.214	0.163	0.167	0.090
	Ulva	1	1.41E+09	1.41E+09	2.948	0.112		
	CO_2 x *Ulva*	1	5.06E+08	5.06E+08	1.061	0.323		
	Residual	12	5.73E+09	4.77E+08				
	Total	15	8.69E+09	5.80E+08				
Crassostrea virginica (small)	CO_2	1	6.25E+08	6.25E+08	1.049	0.326	0.277	0.498
	Ulva	1	6.25E+08	6.25E+08	1.049	0.326		
	CO_2 x *Ulva*	1	1.00E+08	1.00E+08	0.168	0.689		
	Residual	12	7.15E+09	5.96E+08				
	Total	15	8.50E+09	5.67E+08				
Crassostrea virginica (large)	CO_2	1	7.50E+07	7.50E+07	0.6	0.461	0.536	0.209
	Ulva	1	2.08E+08	2.08E+08	1.667	0.233		
	CO_2 x *Ulva*	1	8.33E+06	8.33E+06	0.0667	0.803		
	Residual	8	1.00E+09	1.25E+08				
	Total	11	1.29E+09	1.17E+08				
Argopecten irradians (small)	CO_2	1	5.63E+07	5.63E+07	0.36	0.560	0.781	0.330
	Ulva	1	1.56E+08	1.56E+08	1	0.337		
	CO_2 x *Ulva*	1	6.25E+06	6.25E+06	0.04	0.845		
	Residual	12	1.88E+09	1.56E+08				
	Total	15	2.09E+09	1.40E+08				
Argopecten irradians (large)	CO_2	1	1.33E+08	1.33E+08	0.372	0.559	0.146	1.000
	Ulva	1	5.33E+08	5.33E+08	1.488	0.257		
	CO_2 x *Ulva*	1	3.33E+07	3.33E+07	0.093	0.768		
	Residual	8	2.87E+09	3.58E+08				
	Total	11	3.57E+09	3.24E+08				
Mytilus edulis	CO_2	1	4.00E+08	4.00E+08	3.310	0.094	0.658	0.780
	Ulva	1	2.50E+07	2.50E+07	0.207	0.657		
	CO_2 x *Ulva*	1	2.50E+07	2.50E+07	0.207	0.657		
	Residual	12	1.45E+09	1.21E+08				
	Total	15	1.90E+09	1.27E+08				

Table S14. Two-way analyses of variance for total alkalinity for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results. Shapiro-Wilk test used to test for normality.

Species (size class)	Source of Variation	DF	SS	MS	F	P	P (Normality)	P (Equal variance)
Mercenaria mercenaria (small)	CO_2	1	0.000965	0.000965	81.98	<0.001*	0.326	0.077
	Ulva	1	3.44E-06	3.44E-06	0.292	0.592		
	CO_2 x *Ulva*	1	7.37E-08	7.37E-08	0.00626	0.937		
	Residual	37	0.000435	1.18E-05				
	Total	40	0.00142	3.55E-05				
Mercenaria mercenaria (large)	CO_2	1	0.0011	0.0011	400.319	<0.001*	0.207	0.093
	Ulva	1	0.000477	0.000477	173.552	<0.001*		
	CO_2 x *Ulva*	1	0.0221	0.0221	8048.682	<0.001*		
	Residual	27	7.42E-05	2.75E-06				
	Total	30	0.0226	0.000754				
Crassostrea virginica (small)	CO_2	1	0.00646	0.00646	364.695	<0.001*	0.389	0.189
	Ulva	1	0.00139	0.00139	78.226	<0.001*		
	CO_2 x *Ulva*	1	0.000124	0.000124	6.974	0.013*		
	Residual	29	0.000514	1.77E-05				
	Total	32	0.00833	0.00026				
Crassostrea virginica (large)	CO_2	1	0.0197	0.0197	4158.61	<0.001*	0.112	0.108
	Ulva	1	2.29E-05	2.29E-05	4.827	0.038*		
	CO_2 x *Ulva*	1	0.00317	0.00317	666.906	<0.001*		
	Residual	24	0.000114	4.75E-06				
	Total	27	0.023	0.00085				
Argopecten irradians (small)	CO_2	1	0.00117	0.00117	555.294	<0.001*	0.254	0.306
	Ulva	1	0.00229	0.00229	1089.085	<0.001*		
	CO_2 x *Ulva*	1	0.00018	0.00018	85.748	<0.001*		
	Residual	14	2.94E-05	2.1E-06				
	Total	17	0.00427	0.000251				
Argopecten irradians (large)	CO_2	1	0.00288	0.00288	532.256	<0.001*	0.116	0.251
	Ulva	1	0.00193	0.00193	357.03	<0.001*		
	CO_2 x *Ulva*	1	0.000795	0.000795	146.962	<0.001*		
	Residual	48	0.00026	5.41E-06				
	Total	51	0.00586	0.000115				
Mytilus edulis	CO_2	1	0.00106	0.00106	85.398	<0.001*	0.214	0.300
	Ulva	1	0.00252	0.00252	202.719	<0.001*		
	CO_2 x *Ulva*	1	0.000926	0.000926	74.369	<0.001*		
	Residual	26	0.000324	1.25E-05				
	Total	29	0.00461	0.000159				

Table S15. Two-way analyses of variance for OH^- concentrations for smaller and larger cohorts of hard clams (*Mercenaria mercenaria*), eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), and blue mussels (*Mytilus edulis*). Asterisks next to p-values represent significant results. Shapiro-Wilk test used to test for normality.

Species (size class)	Source of Variation	DF	SS	MS	F	P	P (Normality)	P (Equal variance)
Mercenaria mercenaria (small)	CO_2	1	4.285	4.285	2445.715	<0.001*	0.974	0.992
	Ulva	1	0.0149	0.0149	8.506	0.006*		
	CO_2 x *Ulva*	1	0.000697	0.000697	0.398	0.532		
	Residual	37	0.0648	0.00175				
	Total	40	4.407	0.11				
Mercenaria mercenaria (large)	CO_2	1	2.841	2.841	3668.582	<0.001*	0.063	0.160
	Ulva	1	0.0124	0.0124	16.008	<0.001*		
	CO_2 x *Ulva*	1	0.0046	0.0046	5.941	0.021*		
	Residual	28	0.0217	0.000774				
	Total	31	2.91	0.0939				
Crassostrea virginica (small)	CO_2	1	3.818	3.818	1464.203	<0.001*	0.090	0.447
	Ulva	1	0.0157	0.0157	6.029	0.020*		
	CO_2 x *Ulva*	1	0.00452	0.00452	1.734	0.198		
	Residual	30	0.0782	0.00261				
	Total	33	3.9	0.118				
Crassostrea virginica (large)	CO_2	1	3.441	3.441	1199.203	<0.001*	0.482	0.198
	Ulva	1	0.0168	0.0168	5.865	0.020*		
	CO_2 x *Ulva*	1	0.00264	0.00264	0.919	0.344		
	Residual	37	0.106	0.00287				
	Total	40	3.585	0.0896				
Argopecten irradians (small)	CO_2	1	2.808	2.808	903.999	<0.001*	0.193	0.098
	Ulva	1	0.0176	0.0176	5.67	0.025*		
	CO_2 x *Ulva*	1	0.0055	0.0055	1.772	0.195		
	Residual	26	0.0808	0.00311				
	Total	29	2.941	0.101				
Argopecten irradians (large)	CO_2	1	4.147	4.147	5924.73	<0.001*	0.067	0.109
	Ulva	1	0.0111	0.0111	15.8	<0.001*		
	CO_2 x *Ulva*	1	0.000231	0.000231	0.33	0.568		
	Residual	42	0.0294	0.0007				
	Total	45	4.193	0.0932				
Mytilus edulis	CO_2	1	2.93	2.93	493.828	<0.001*	0.248	0.107
	Ulva	1	0.037	0.037	6.241	0.020*		
	CO_2 x *Ulva*	1	0.0252	0.0252	4.25	0.050		
	Residual	24	0.142	0.00593				
	Total	27	3.2	0.119				

Figure S1. Mean growth rates of *Ulva* exposed to ambient and elevated CO_2 conditions for June through November experiments.

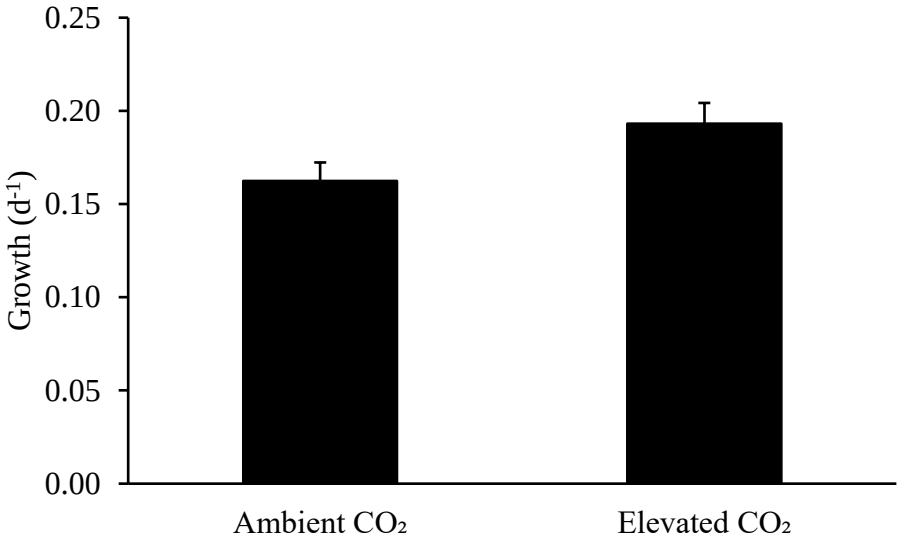

Figure S2. Daily pH_{Total} of treatments with and without *Ulva* for (a) smaller cohorts of *Mercenaria mercenaria*, (b) larger cohorts of *Mercenaria mercenaria*, (c) smaller cohorts of *Crassostrea virginica*, (d) larger cohorts of *Crassostrea virginica*, (e) smaller cohorts of *Argopecten irradians*, (f) larger cohorts of *Argopecten irradians*, and (g) *Mytilus edulis* exposed to ambient CO_2 concentrations. Black vertical lines indicate days when water changes were performed, and measurements were taken following the water change.

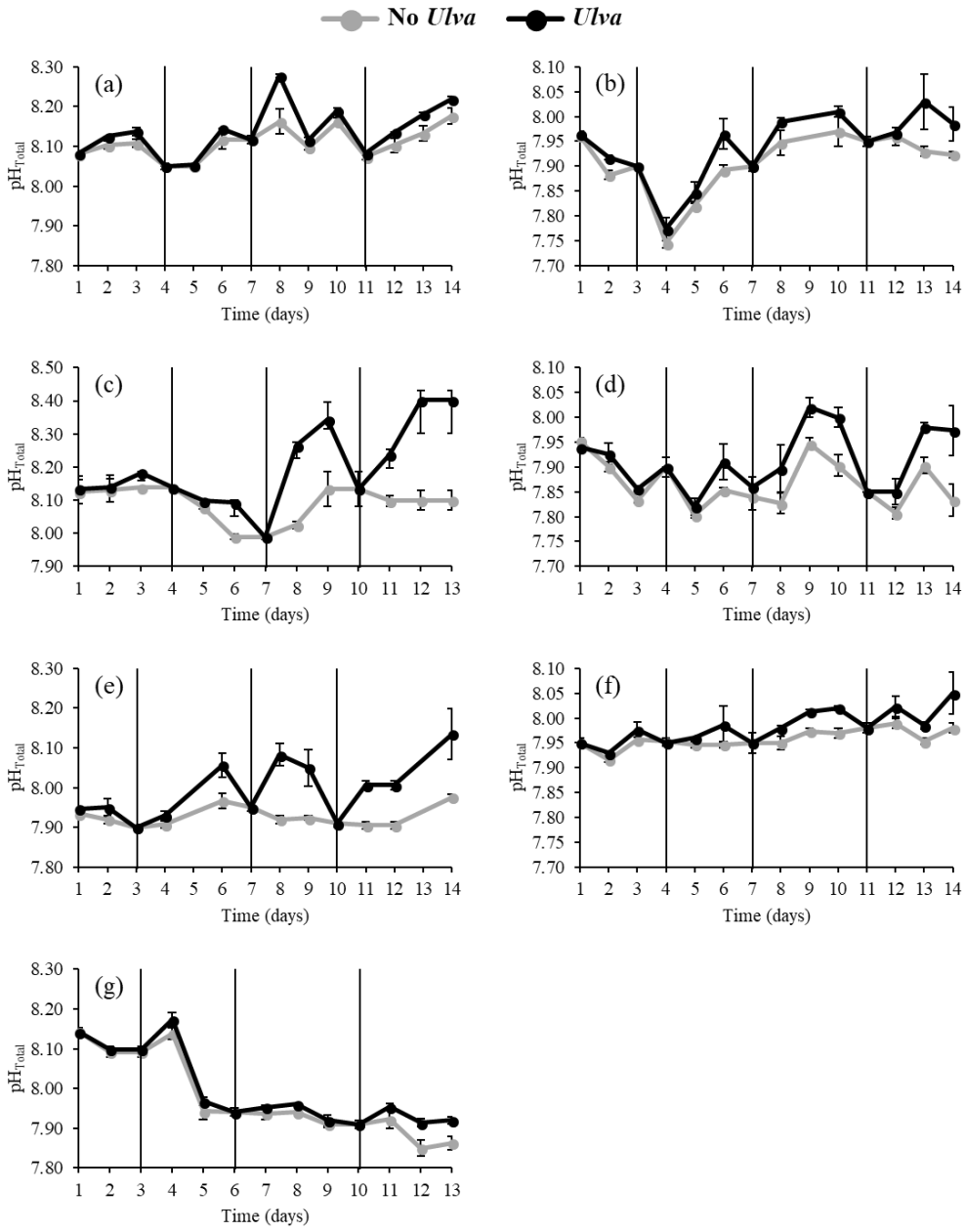

Figure S3. Daily pH_{Total} of treatments with and without *Ulva* for (a) smaller cohorts of *Mercenaria mercenaria*, (b) larger cohorts of *Mercenaria mercenaria*, (c) smaller cohorts of *Crassostrea virginica*, (d) larger cohorts of *Crassostrea virginica*, (e) smaller cohorts of *Argopecten irradians*, (f) larger cohorts of *Argopecten irradians*, and (g) *Mytilus edulis* exposed to elevated CO_2 concentrations. Black vertical lines indicate days when water changes were performed, and measurements were taken following the water change.

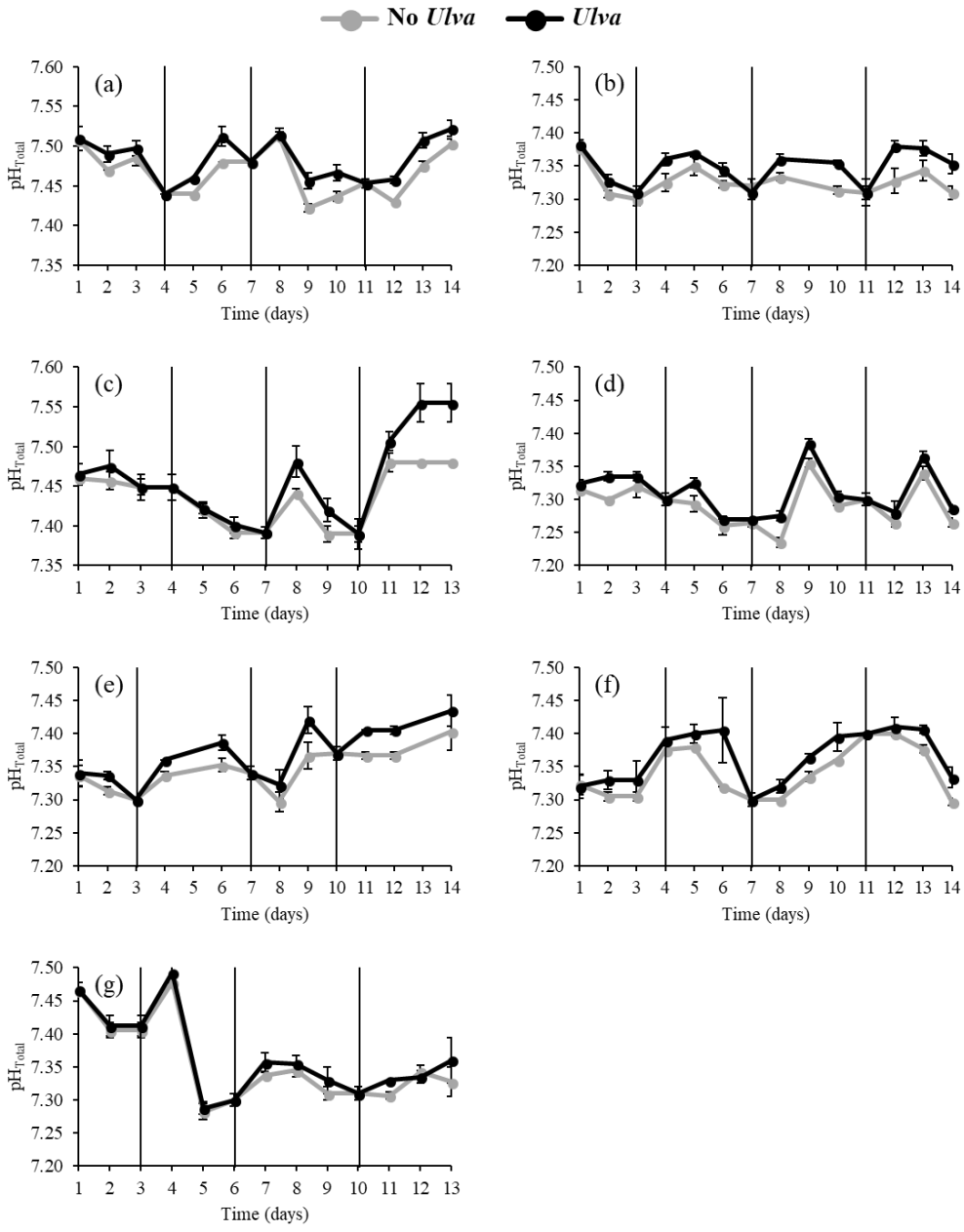

Figure S4. Diurnal cycles of pH_{NBS} of (a) ambient CO_2, and (b) elevated CO_2 treatments containing *Ulva*. Shaded boxes represent the time range in which daily discrete pH measurements were made. Continuous pH measurements were made in individual vessels for only some experiments.