

Supporting Information

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Table S1. ANOVA table on measured response variables

Factors	df	MS	F	P
Benthic microalgae biomass				
W	1	549.20	0.98	0.331
A	1	318.80	0.57	0.458
M	1	1,845.90	3.28	0.080
W × A	1	299.20	0.53	0.452
W × M	1	549.20	0.98	0.331
A × M	1	2,196.80	3.90	0.057
W × A × M	1	299.20	0.53	0.472
Sediment faunal biomass				
W	1	0.21	14.08	0.001
A	1	0.00	0.01	0.937
M	1	0.54	36.88	0.000
W × A	1	0.00	0.02	0.898
W × M	1	0.07	5.08	0.031
A × M	1	0.02	1.13	0.290
W × A × M	1	0.00	0.00	0.958
Benthic microalgae primary production				
W	1	2.02	0.05	0.825
A	1	195.68	4.81	0.036
M	1	124.71	3.06	0.090
W × A	1	131.93	3.24	0.082
W × M	1	52.54	1.29	0.265
A × M	1	13.44	0.33	0.570
W × A × M	1	32.85	0.81	0.376
Macroalgal biomass				
W	1	47.08	9.92	0.003
A	1	3.77	0.79	0.379
M	1	76.37	16.09	0.000
W × A	1	33.70	7.10	0.012
W × M	1	60.49	1.37	0.251
A × M	1	0.11	0.02	0.881
W × A × M	1	0.00	0.00	0.986
Z. marina biomass				
W	1	0.03	0.24	0.621
A	1	0.47	3.31	0.078
M	1	7.00	47.62	0.000
W × A	1	0.04	0.29	0.592
W × M	1	0.66	4.63	0.039
A × M	1	0.21	1.48	0.023
W × A × M	1	0.14	0.06	0.810

Effects of warming (W), ocean acidification (A), and mesograzers presence (M) tested by type I ANOVA on benthic microalgae biomass, benthic microalgae primary production, sediment faunal biomass, macroalgal biomass, and *Zostera marina* biomass.

Table S2. ANOVA table for mesograzer biomass

Variables	Factors	df	MS	F	P
<i>G. locusta</i>	W	1	0.09	5.74	0.030
	A	1	0.01	0.40	0.530
	W × A	1	2.11	2.11	0.160
<i>L. littorea</i>	W	1	0.01	0.22	0.640
	A	1	0.12	1.95	0.180
	W × A	1	0.09	1.57	0.230
<i>Rissoa</i> sp.	W	1	0.00	0.19	0.670
	A	1	0.00	0.01	0.910
	W × A	1	0.00	0.48	0.490

Effects of warming (W) and ocean acidification (A) tested by type I ANOVA on biomass of *Gammarus locusta*, *Littorina littorea*, and *Rissoa* sp.

Table S3. Investigation of model intercepts between groups with chi squares (χ^2)

Variable	Intercepts different across groups	Intercepts equal across groups	Difference in model χ^2
Model A (benthic microalgae biomass)			
Macroalgae	16.7	29.6	12.9
Sediment fauna	16.7	24.4	7.7
<i>Zostera</i>	16.7	37.3	20.6
Light	16.7	16.8	0.1
Benthic microalgae biomass	16.7	17.8	1.1
Model B (benthic microalgae primary production)			
Macroalgae	17.2	31.2	14.0
Sediment fauna	17.2	24.9	7.7
<i>Zostera</i>	17.2	37.9	20.7
Light	17.2	17.4	0.2
Benthic microalgae primary production	17.2	17.6	0.4

First, all intercepts were allowed to differ across groups. Second, each variable was investigated by setting the intercept as equal across groups, which changed the model χ^2 . The difference in model χ^2 indicates whether the intercept is significantly different across groups.

Table S4. Standardized total, direct, and indirect effects for the group mesograzers absent in model A (BMA biomass)

	Warm	Acid	Warm × acid	Sediment fauna	Macroalgae	<i>Zostera</i>	Light
Standardized total effects							
Sediment fauna	0.697	0.022	0.575	0.000	0.000	0.000	0.000
Macroalgae	0.183	-0.282	0.597	-0.498	0.000	0.000	0.000
<i>Zostera</i>	0.143	0.305	0.605	-0.053	0.117	0.000	0.000
Light	-0.110	0.134	-0.367	0.249	-0.555	-0.067	0.000
BMA (biomass)	-0.210	0.099	0.350	-1.004	-0.598	0.007	0.217
Standardized direct effects							
Sediment fauna	0.697	0.022	0.575	0.000	0.000	0.000	0.000
Macroalgae	0.495	-0.272	0.854	-0.448	0.000	0.000	0.000
<i>Zostera</i>	0.121	0.338	0.535	0.000	0.117	0.000	0.000
Light	0.000	0.000	0.000	0.000	-0.547	-0.067	0.000
BMA (biomass)	0.786	-0.044	1.435	-1.272	-0.480	0.021	0.217
Standardized indirect effects							
Sediment fauna	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Macroalgae	-0.312	-0.010	-0.258	0.000	0.000	0.000	0.000
<i>Zostera</i>	0.021	-0.033	0.070	-0.053	0.000	0.000	0.000
Light	-0.11	0.134	-0.367	0.249	-0.008	0.000	0.000
BMA (biomass)	-0.995	0.143	-1.085	0.268	-0.118	-0.015	0.000

"Total effects" are the sum of all direct and indirect effects. "Direct effects" are the direct effects of one variable on another variable, and "indirect effects" are sum of all products affecting one variable (e.g., the indirect effect of WARM on ALGAE is the product of the path between WARM → FAUNA and FAUNA → ALGAE). BMA, benthic microalgae; PP, primary production.

Table S5. Standardized total, direct, and indirect effects for the group mesograzers present in model A (BMA biomass)

	Warm	Acid	Warm × acid	Sediment fauna	Macroalgae	Zostera	Light
Standardized total effects							
Sediment fauna	0.156	0.031	0.311	0.000	0.000	0.000	0.000
Macroalgae	-0.071	-0.175	0.406	0.243	0.000	0.000	0.000
Zostera	0.128	0.319	-0.025	0.023	0.095	0.000	0.000
Light	0.051	0.126	-0.214	-0.124	-0.509	0.109	0.000
BMA biomass	0.283	-0.144	0.159	0.071	-0.087	-0.006	0.318
Standardized direct effects							
Sediment fauna	0.156	0.031	0.311	0.000	0.000	0.000	0.000
Macroalgae	-0.109	-0.182	0.330	0.243	0.000	0.000	0.000
Zostera	0.135	0.336	-0.063	0.000	0.095	0.000	0.000
Light	0.000	0.000	0.000	0.000	-0.520	0.109	0.000
BMA biomass	0.263	-0.160	0.166	0.092	0.079	-0.040	0.318
Standardized indirect effects							
Sediment fauna	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Macroalgae	0.038	0.008	0.076	0.000	0.000	0.000	0.000
Zostera	-0.007	-0.017	0.039	-0.023	0.000	0.000	0.000
Light	0.051	0.126	-0.214	-0.124	0.010	0.000	0.000
BMA biomass	0.02	0.016	-0.006	-0.021	-0.166	0.035	0.000

Total effects are the sum of all direct and indirect effects. Direct effects are the direct effects of one variable on another variable, and indirect effects are sum of all products affecting one variable (e.g., the indirect effect of WARM on ALGAE is the product of the path between WARM → FAUNA and FAUNA → ALGAE). BMA, benthic microalgae.

Table S6. Standardized total, direct, and indirect effects for the group mesograzers absent in model B (BMA PP)

	Warm	Acid	Warm × acid	Sediment fauna	Macroalgae	Zostera	Light
Standardized total effects							
Sediment fauna	0.680	0.038	0.526	0.000	0.000	0.000	0.000
Macroalgae	0.214	-0.221	0.629	-0.459	0.000	0.000	0.000
Zostera	0.146	0.311	0.608	-0.054	0.117	0.000	0.000
Light	-0.400	0.016	-0.397	0.269	-0.586	-0.053	0.000
BMA PP	0.090	-0.036	-0.367	-0.127	-0.150	0.051	0.034
Standardized direct effects							
Sediment fauna	0.680	0.038	0.562	0.000	0.000	0.000	0.000
Macroalgae	0.526	-0.204	0.887	-0.459	0.000	0.000	0.000
Zostera	0.121	0.337	0.534	0.000	0.117	0.000	0.000
Light	-0.268	-0.096	0.000	0.000	-0.580	-0.053	0.000
BMA PP	0.259	-0.075	-0.190	-0.196	-0.136	0.053	0.034
Standardized indirect effects							
Sediment fauna	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Macroalgae	-0.312	-0.018	-0.258	0.000	0.000	0.000	0.000
Zostera	0.025	-0.026	0.074	-0.054	0.000	0.000	0.000
Light	-0.132	0.112	-0.397	0.269	-0.006	0.000	0.000
BMA PP	-0.168	0.039	-0.177	0.069	-0.014	-0.002	0.000

Total effects are the sum of all direct and indirect effects. Direct effects are the direct effects of one variable on another variable, and indirect effects are sum of all products affecting one variable (e.g., the indirect effect of WARM on ALGAE is the product of the path between WARM → FAUNA and FAUNA → ALGAE). BMA, benthic microalgae; PP, primary production.

Table S7. Standardized total, direct, and indirect effects for the group mesgrazers present in model B (BMA PP)

	Warm	Acid	Warm × acid	Sediment fauna	Macroalgae	Zostera	Light
Standardized total effects							
Sediment fauna	0.183	0.061	0.351	0.000	0.000	0.000	0.000
Macroalgae	-0.115	-0.261	0.356	0.234	0.000	0.000	0.000
Zostera	0.124	0.311	-0.029	0.023	0.096	0.000	0.000
Light	0.103	0.168	-0.188	-0.119	-0.510	0.113	0.000
BMA PP	0.245	-0.144	-0.404	0.208	0.060	0.009	-0.279
Standardized direct effects							
Sediment fauna	0.183	0.061	0.351	0.000	0.000	0.000	0.000
Macroalgae	-0.157	-0.275	0.274	0.234	0.000	0.000	0.000
Zostera	0.135	0.307	-0.063	0.000	0.096	0.000	0.000
Light	0.029	-0.003	0.000	0.000	-0.521	0.113	0.000
BMA PP	0.223	-0.144	-0.492	0.194	-0.086	0.041	-0.279
Standardized indirect effects							
Sediment fauna	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Macroalgae	0.043	0.014	0.082	0.000	0.000	0.000	0.000
Zostera	-0.011	-0.025	0.034	0.023	0.000	0.000	0.000
Light	0.074	0.171	-0.188	-0.119	0.011	0.000	0.000
BMA PP	0.022	0.000	0.089	0.014	0.146	-0.031	0.000

Total effects are the sum of all direct and indirect effects. Direct effects are the direct effects of one variable on another variable, and indirect effects are sum of all products affecting one variable (e.g., the indirect effect of WARM on ALGAE is the product of the path between WARM → FAUNA and FAUNA → ALGAE). BMA, benthic microalgae; PP, primary production.

Table S8. Properties of the carbonate system after running the experiment for 15 of 35 d in total

Properties of the carbonate system	No warming/no acidification	Warming/no acidification	No warming/acidification	Warming/acidification
Day 15				
Salinity	22.89 ± 0.1	23.07 ± 0.1	22.88 ± 0.1	23.13 ± 0.1
Temperature, °C	19.45 ± 0.3	23.31 ± 0.4	19.50 ± 0.3	23.29 ± 0.4
TA, mmol·kg SW ⁻¹	1,635 ± 76.4	1,707 ± 71.6	1,708 ± 107.0	1,726 ± 145.9
tCO ₂ , mmol·kg SW ⁻¹	1,442 ± 62.3	1,437 ± 59.4	1,620 ± 101.4	1,620 ± 137.3
pH	8.21 ± 0.01	8.22 ± 0.01	7.86 ± 0.01	7.86 ± 0.1
HCO ₃ ⁻ , mmol·kg SW ⁻¹	1,220 ± 52	1,302 ± 50.4	1,528 ± 95.1	1,517 ± 128.3
CO ₃ ²⁻ , mmol·kg SW ⁻¹	137.2 ± 11.0	164.5 ± 13.9	73.22 ± 8.6	85.08 ± 15.4
CO ₂ , mmol·kg SW ⁻¹	7.15 ± 0.3	6.42 ± 0.5	18.68 ± 1.9	17.16 ± 2.9
Ω calcite	3.56 ± 0.3	4.32 ± 0.4	1.90 ± 0.2	2.23 ± 0.4
Ω aragonite	2.22 ± 0.2	2.72 ± 0.2	1.18 ± 0.1	1.40 ± 0.3
pCO ₂ , ppm	204 ± 7.8	204 ± 15.5	534 ± 55.9	545 ± 93.1
Day 28				
Salinity	28.65 ± 0.2	28.83 ± 0.2	28.55 ± 0.4	28.45 ± 1.5
Temperature, °C	17.95 ± 0.2	21.01 ± 0.5	17.92 ± 0.2	21.32 ± 0.4
TA, mmol·kg SW ⁻¹	1,441 ± 45.7	1,496 ± 80.7	1,524 ± 114.9	1,561 ± 102.7
TCO ₂ , mmol·kg SW ⁻¹	1,280 ± 36.3	1,286 ± 63.9	1,440 ± 112.1	1,460 ± 94.7
pH	8.07 ± 0.02	8.14 ± 0.07	7.80 ± 0.05	7.81 ± 0.05
HCO ₃ ⁻ , mmol·kg SW ⁻¹	1,169 ± 33.4	1,154 ± 52.6	1,358 ± 106.5	1,369 ± 87.6
CO ₃ ²⁻ , mmol·kg SW ⁻¹	102.14 ± 4.6	131.15 ± 22.1	63.09 ± 7.3	74.03 ± 9.9
CO ₂ , mmol·kg SW ⁻¹	8.29 ± 0.4	6.34 ± 1.6	18.23 ± 2.4	16.72 ± 1.7
Ω calcite	2.54 ± 0.1	3.64 ± 1.4	1.57 ± 0.2	1.85 ± 0.2
Ω aragonite	1.62 ± 0.07	2.33 ± 0.9	1.00 ± 0.1	1.19 ± 0.2
pCO ₂ , ppm	233 ± 11.2	206 ± 30.4	514 ± 68.5	518 ± 53.8

SW, sea water; TA, total alkalinity. Shown are means ± 1 SD; n = 15. Reproduced from (1). Copyright Blackwell Publishing Ltd/CNRS.

1. Eklöf JS, et al. (2012) Experimental climate change weakens the insurance effect of biodiversity. *Ecol Lett* 15(8):864–872.