

The following supplement accompanies the article

Adaptive capacity of the sea urchin *Heliocidaris erythrogramma* to ocean change stressors: responses from gamete performance to the juvenile

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Table S1. Experimental conditions in experiments with *Heliocidaris erythrogramma*. Mean values (\pm SE, n = 33) for pH_{NIST} measured daily per treatment is presented with pH_T (determined using tris buffers) for comparison. pH_T, pCO₂ and the saturation states of calcite (Ω_{ca}) and aragonite (Ω_{ar}) were calculated in CO2SYS using data on DIC and total alkalinity (TA = 2205.2 \pm 9.3 μ mol/kg, n = 12), salinity (33.6 \pm 0.06, n = 14) and temperature for each treatment.

	24 °C			27 °C		
	pH 8.1	pH 7.8	pH 7.6	pH 8.1	pH 7.8	pH 7.6
Temp	23.57 (0.08)	23.60 (0.09)	23.82 (0.08)	26.53 (0.06)	26.21 (0.06)	26.70 (0.13)
pH _T	8.10 (0.01)	7.80 (0.00)	7.63 (0.00)	8.12 (0.00)	7.80 (0.00)	7.63 (0.00)
pH _{NIST}	8.18 (0.01)	7.88 (0.01)	7.69 (0.00)	8.18 (0.01)	7.83 (0.00)	7.70 (0.00)
pCO ₂	386.30 (6.40)	874.23 (10.21)	1408.67 (15.39)	388.03 (5.29)	987.80 (10.32)	1419.34 (17.36)
Ω_{Ca}	4.67 (0.05)	2.60 (0.03)	1.77 (0.02)	5.06 (0.05)	2.58 (0.02)	1.96 (0.01)
Ω_{Ar}	3.06 (0.03)	1.70 (0.02)	1.16 (0.01)	3.34 (0.03)	1.70 (0.02)	1.29 (0.01)

Table S2. ANOVA of percentage of fertilisation, normal larvae and metamorphosed larvae of *Heliocidaris erythrogramma*. ANOVA of data of single dam-sire crosses across temperature (Te) and pH treatments. Temperature and pH are fixed factors, experimental block (Bl) a random factor, and male (Ma) and female (Fe) identity random factors nested within block. Significant effects are shown in bold ($P < 0.05$).

Source	df	MS	Fertilisation			Larvae				Metamorphosed			
			F	P(perm)	%	MS	F	P(perm)	%	MS	F	P(per m)	%
Bl	1	672.62	0.23	0.93	0	8122.60	11.77	0.01	0	354.84	0.25	0.92	0
pH	2	1509.20	6.43	0.22	-	4213.00	43.21	0.02	-	2648.30	6.44	0.27	-
Te	1	11666.00	197.66	0.05	-	1.81E+05	15.81	0.25	-	44312.00	15.52	0.25	-
Ma(Bl)	6	2725.40	9.93	0.00	15.47	718.18	0.40	0.89	0	1206.70	3.55	0.08	0
Fe(Bl)	2	1324.90	4.83	0.06	1.38	125.98	6.97E-02	0.93	0	1565.90	4.61	0.07	0
BlxpH	2	234.87	0.65	0.72	0	97.51	0.28	0.97	0	411.17	0.48	0.85	0
BlxTe	1	59.02	0.13	0.98	0	11419.00	2.26	0.16	13.1	2854.90	1.77	0.23	0
pHxTe	2	809.25	1.86	0.35	-	3624.40	14.75	0.07	-	8162.20	5.15	0.17	-
Ma(Bl)xFe(Bl)	6	274.57	1.02	0.42	0.19	1808.60	4.34	0.00	0	339.81	1.00	0.43	0
Ma(Bl)xpH	12	406.41	1.51	0.25	0	1239.80	1.45	0.26	0	1599.00	1.75	0.17	0
Ma(Bl)xTe	6	430.71	3.39	0.08	0	1357.60	2.60	0.14	0.21	1372.40	3.36	0.08	0
Fe(Bl)xpH	4	368.38	1.37	0.30	0.57	2153.60	2.52	0.10	0	1155.60	1.27	0.33	0
Fe(Bl)xTe	2	1008.30	7.94	0.02	3.55	3931.90	7.54	0.02	1.74	467.97	1.15	0.38	0
BlxpHxTe	2	435.40	1.32	0.31	0	245.81	0.34	0.94	0	1585.30	0.71	0.68	6.23
Ma(Bl)xFe(Bl)xpH	12	269.95	1.00	0.45	0.09	853.17	2.05	0.02	9.52	913.08	2.69	0.00	4.61
Ma(Bl)xFe(Bl)xTe	6	126.92	0.47	0.83	0	521.61	1.25	0.28	4.58	408.58	1.20	0.31	0
Ma(Bl)xpHxTe	12	418.05	1.68	0.19	6.94	624.95	1.38	0.30	4.56	1053.70	1.87	0.15	17.69
Fe(Bl)xpHxTe	4	102.50	0.41	0.80	0	1420.20	3.13	0.06	10.31	1986.40	3.53	0.04	10.18
Ma(Bl)xFe(Bl)xpHxTe	12	249.09	0.92	0.53	0	453.52	1.09	0.37	1.54	562.25	1.66	0.08	9.31
Res	192	270.15				416.36				339.44			

Table S3. ANOVA of number of spines present on metamorphosed larvae of *Heliocidaris erythrogramma*. ANOVA of data of single dam-sire crosses across temperature (Te) and pH treatments. Temperature and pH are fixed factors, experimental block (Bl) a random factor, and male (Ma) and female (Fe) identity random factors nested within block. Significant effects are shown in bold ($P < 0.05$).

Source	df	Spines		
		MS	F	P(perm)
Bl	1	2.38	0.13	0.98
pH	2	113.70	1.56	0.39
Te	1	357.59	79.72	0.07
Ma(Bl)	6	25.94	1.13	0.45
Fe(Bl)	2	170.43	7.43	0.02
BlxpH	2	72.87	2.08	0.11
BlxTe	1	4.49	0.51	0.75
pHxTe	2	143.45	3.75	0.21
Ma(Bl)xFe(Bl)	6	22.95	5.53	0.00
Ma(Bl)xpH	12	19.92	0.71	0.72
Ma(Bl)xTe	6	34.93	1.02	0.49
Fe(Bl)xpH	4	28.69	1.02	0.43
Fe(Bl)xTe	2	41.44	1.21	0.36
BlxpHxTe	2	38.25	2.32	0.09
Ma(Bl)xFe(Bl)xpH	12	28.10	6.77	0.00
Ma(Bl)xFe(Bl)xTe	6	34.29	8.27	0.00
Ma(Bl)xpHxTe	12	9.63	0.26	0.99
Fe(Bl)xpHxTe	4	23.23	0.61	0.66
Ma(Bl)xFe(Bl)xpHxTe	12	37.81	9.12	0.00
Res	192	4.15		
Total	287			