

Supplementary Material

Table S1: Stage survival and morphological measurements for each $p\text{CO}_2$ condition of exposure at each stage of development.

stage	$p\text{CO}_2$		Survival (%)		Rostrum (mm)		Cephalothorax (mm)		Abdomen (mm)		Tail (mm)		Claw (mm)		Total length (mm)		Abdomen / Total length		Cephalothorax / Total length		Cephalothorax / Abdomen	
	μatm				Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
I	400	20	51	13	1.61	0.04	1.79	0.03	2.68	0.05	1.33	0.05	0.81	0.04	4.47	0.07	0.60	0.01	0.40	0.01	0.67	0.02
I	600	18	54	7	1.54	0.04	1.88	0.06	2.69	0.08	1.33	0.04	0.89	0.05	4.57	0.12	0.59	0.01	0.41	0.01	0.71	0.02
I	800	20	59	7	1.57	0.03	1.90	0.05	2.80	0.06	1.40	0.03	0.75	0.03	4.70	0.06	0.60	0.01	0.40	0.01	0.69	0.03
I	1000	20	47	13	1.46	0.07	2.08	0.10	2.83	0.11	1.31	0.05	0.83	0.05	4.90	0.20	0.58	0.01	0.42	0.01	0.74	0.02
I	1200	18	67	5	1.56	0.04	2.08	0.09	2.91	0.12	1.38	0.05	0.94	0.06	4.99	0.20	0.58	0.01	0.42	0.01	0.72	0.03
I	2000	15	53	8	1.59	0.05	1.92	0.07	2.79	0.10	1.35	0.05	0.77	0.05	4.71	0.14	0.59	0.01	0.41	0.01	0.70	0.03
I	3000	20	78	10	1.48	0.06	1.90	0.08	2.79	0.08	1.34	0.05	0.83	0.03	4.68	0.14	0.60	0.01	0.40	0.01	0.68	0.02
II	400	15	100	0	1.65	0.07	2.30	0.08	3.28	0.13	1.37	0.05	0.94	0.05	5.58	0.20	0.59	0.01	0.41	0.01	0.71	0.02
II	600	17	97	3	1.55	0.05	2.57	0.07	3.32	0.07	1.33	0.06	1.04	0.04	5.90	0.10	0.56	0.01	0.44	0.01	0.78	0.03
II	800	20	76	17	1.51	0.07	2.68	0.05	3.49	0.07	1.39	0.05	1.08	0.04	6.16	0.09	0.57	0.01	0.43	0.01	0.77	0.02
II	1000	14	90	9	1.54	0.09	2.67	0.06	3.25	0.16	1.45	0.07	1.07	0.06	5.92	0.15	0.54	0.02	0.46	0.02	0.88	0.10
II	1200	20	81	10	1.73	0.05	2.39	0.04	3.41	0.07	1.30	0.08	1.07	0.03	5.81	0.09	0.59	0.01	0.41	0.01	0.70	0.02
II	2000	15	96	4	1.60	0.08	2.56	0.06	3.56	0.07	1.37	0.06	1.05	0.04	6.12	0.10	0.58	0.01	0.42	0.01	0.72	0.02
II	3000	15	63	8	1.58	0.06	2.39	0.06	3.30	0.07	1.33	0.05	1.02	0.03	5.69	0.10	0.58	0.01	0.42	0.01	0.73	0.02
III	400	15	61	10	1.97	0.07	2.92	0.05	3.76	0.07	1.63	0.08	1.48	0.06	6.68	0.09	0.56	0.01	0.44	0.01	0.78	0.02
III	600	15	87	10	1.85	0.12	2.78	0.14	3.61	0.15	1.50	0.11	1.41	0.08	6.39	0.28	0.57	0.01	0.43	0.01	0.77	0.02
III	800	20	76	9	1.90	0.10	2.97	0.05	3.85	0.08	1.73	0.06	1.52	0.03	6.81	0.08	0.56	0.01	0.44	0.01	0.78	0.03
III	1000	20	59	9	1.86	0.05	3.01	0.04	3.74	0.08	1.69	0.05	1.48	0.04	6.75	0.09	0.55	0.01	0.45	0.01	0.81	0.02
III	1200	20	86	7	1.97	0.07	2.93	0.05	3.60	0.06	1.68	0.03	1.50	0.04	6.54	0.09	0.55	0.00	0.45	0.00	0.82	0.01
III	2000	14	78	9	2.01	0.09	3.08	0.04	3.81	0.07	1.68	0.03	1.56	0.05	6.88	0.09	0.55	0.00	0.45	0.00	0.81	0.01
III	3000	15	71	10	1.69	0.10	3.15	0.04	3.83	0.05	1.67	0.05	1.47	0.05	6.97	0.08	0.55	0.00	0.45	0.00	0.82	0.01
IV	400	6	23	3	1.94	0.13	3.79	0.08	4.15	0.09	1.76	0.32	3.21	0.19	7.94	0.09	0.52	0.01	0.48	0.01	0.92	0.03
IV	600	5	33	9	1.95	0.08	3.71	0.08	4.00	0.21	1.84	0.04	3.18	0.17	7.72	0.29	0.52	0.01	0.48	0.01	0.93	0.03
IV	800	6	37	9	2.17	0.08	3.78	0.04	4.43	0.11	1.83	0.13	3.29	0.06	8.21	0.15	0.54	0.00	0.46	0.00	0.86	0.02
IV	1000	6	30	12	2.02	0.10	3.64	0.07	3.76	0.06	2.11	0.09	3.00	0.06	7.40	0.08	0.51	0.01	0.49	0.01	0.97	0.03
IV	1200	8	30	4	2.04	0.11	3.65	0.08	3.86	0.12	2.07	0.07	3.09	0.09	7.51	0.18	0.51	0.01	0.49	0.01	0.95	0.02
IV	2000	5	10	6	1.96	0.05	3.64	0.08	3.71	0.13	1.92	0.08	2.82	0.33	7.36	0.19	0.50	0.01	0.50	0.01	0.98	0.03
IV	3000	6	6	6	1.81	0.13	3.73	0.05	4.01	0.10	2.24	0.08	2.99	0.10	7.74	0.11	0.52	0.01	0.48	0.01	0.93	0.03
V	400	5	0	0	2.11	0.06	4.53	0.07	4.63	0.12	2.74	0.09	4.59	0.20	9.16	0.14	0.51	0.01	0.49	0.01	0.98	0.03
V	600	6	7	7	2.22	0.11	4.51	0.12	4.71	0.18	2.54	0.11	4.43	0.21	9.22	0.30	0.51	0.00	0.49	0.00	0.96	0.01
V	800	6	7	7	1.90	0.10	4.74	0.12	4.91	0.17	2.67	0.10	4.50	0.16	9.65	0.27	0.51	0.00	0.49	0.00	0.97	0.02
V	1000	6	7	7	2.23	0.07	4.63	0.18	4.81	0.17	2.57	0.15	4.80	0.24	9.44	0.31	0.51	0.01	0.49	0.01	0.96	0.03
V	1200	8	0	0	2.10	0.11	4.49	0.11	4.90	0.15	2.44	0.12	3.86	0.29	9.38	0.25	0.52	0.00	0.48	0.00	0.92	0.01

Table S2: Mineral contents in the cephalothorax for each $p\text{CO}_2$ condition of exposure at each stage of development.

Stage	$p\text{CO}_2$	n	Ca^{2+} (mg g ⁻¹ DW)		Mg^{2+} (mg g ⁻¹ DW)		Na^+ (mg g ⁻¹ DW)		K^+ (mg g ⁻¹ DW)		Sr^+ (mg g ⁻¹ DW)		[Mg^{2+}]:[Ca^{2+}]		[Ca^{2+}]:[Mg^{2+}]	
			mean	SE	mean	SE	mean	SE	mean	SE	mean	SE	mean	SE	mean	SE
I	400	3	78.35	± 22.69	40.85	± 14.69	153.50	± 14.51	33.22	± 8.26	1.13	± 0.27	0.50	± 0.03	2.04	± 0.13
I	600	3	48.07	± 22.72	13.40	± 6.52	62.80	± 30.13	26.84	± 13.03	0.71	± 0.39	0.23	± 0.06	5.11	± 1.57
I	800	4	59.86	± 11.42	16.51	± 3.56	80.52	± 20.29	32.30	± 6.24	0.75	± 0.15	0.27	± 0.01	3.70	± 0.18
I	1000	4	103.28	± 25.96	23.61	± 3.14	112.84	± 17.54	38.88	± 3.50	1.70	± 0.40	0.25	± 0.03	4.25	± 0.55
I	1200	4	67.35	± 18.77	20.55	± 4.27	133.40	± 13.28	44.75	± 7.73	0.96	± 0.25	0.37	± 0.10	3.17	± 0.63
I	2000	3	79.73	± 31.56	15.11	± 4.59	72.66	± 20.68	21.16	± 4.48	1.26	± 0.52	0.23	± 0.05	4.76	± 0.87
I	3000	4	38.57	± 8.25	12.75	± 2.35	74.83	± 17.39	24.10	± 5.37	0.55	± 0.09	0.35	± 0.06	3.12	± 0.61
II	400	3	121.07	± 40.07	25.13	± 7.17	106.96	± 29.20	37.31	± 9.11	2.05	± 0.67	0.22	± 0.01	4.68	± 0.26
II	600	3	99.05	± 10.17	19.84	± 2.93	95.48	± 20.79	29.41	± 3.04	1.70	± 0.20	0.20	± 0.01	5.07	± 0.26
II	800	4	131.37	± 59.47	30.38	± 11.63	153.49	± 39.28	59.36	± 21.01	2.38	± 1.10	0.47	± 0.25	3.72	± 0.97
II	1000	3	98.12	± 35.02	23.78	± 4.93	112.68	± 2.14	40.76	± 3.23	1.65	± 0.68	0.29	± 0.06	3.82	± 0.74
II	1200	4	83.44	± 17.79	18.50	± 3.30	80.37	± 11.67	33.13	± 6.63	1.53	± 0.32	0.23	± 0.02	4.45	± 0.43
II	2000	3	62.82	± 5.93	12.18	± 1.41	60.84	± 7.99	20.30	± 1.05	1.09	± 0.13	0.19	± 0.01	5.18	± 0.15
II	3000	3	63.85	± 19.90	13.80	± 3.43	55.11	± 14.15	24.73	± 7.59	1.11	± 0.35	0.23	± 0.02	4.50	± 0.34
III	400	3	83.87	± 18.17	13.87	± 4.04	63.58	± 13.64	22.45	± 9.19	1.42	± 0.32	0.16	± 0.01	6.35	± 0.51
III	600	3	101.58	± 20.43	16.84	± 3.16	76.09	± 17.80	29.00	± 5.04	1.77	± 0.35	0.17	± 0.00	6.01	± 0.16
III	800	4	60.31	± 10.71	10.76	± 2.28	39.26	± 6.89	20.60	± 4.82	1.11	± 0.21	0.17	± 0.01	5.78	± 0.33
III	1000	4	112.36	± 49.08	19.53	± 8.43	82.37	± 31.14	33.03	± 16.55	1.98	± 0.86	0.17	± 0.01	5.85	± 0.36
III	1200	4	142.75	± 83.78	26.85	± 16.08	106.17	± 62.43	53.67	± 32.89	2.63	± 1.56	0.19	± 0.01	5.33	± 0.24
III	2000	3	60.05	± 2.65	9.90	± 0.55	42.68	± 4.69	18.21	± 1.39	1.05	± 0.03	0.17	± 0.01	6.10	± 0.40
III	3000	3	110.01	± 28.80	19.06	± 6.26	79.32	± 26.15	35.07	± 12.96	1.94	± 0.53	0.17	± 0.01	5.99	± 0.52
IV	400	3	197.57	± 82.45	18.08	± 5.66	40.62	± 6.25	14.10	± 3.40	3.12	± 1.28	0.11	± 0.02	10.03	± 1.84
IV	600	3	565.94	± 88.02	48.08	± 33.17	70.85	± 44.73	18.98	± 12.03	8.90	± 6.06	0.08	± 0.00	11.81	± 0.30
IV	800	3	291.77	± 79.99	24.79	± 6.88	47.01	± 11.88	14.11	± 3.56	4.66	± 1.35	0.08	± 0.00	11.81	± 0.42
IV	1000	3	259.40	± 94.96	22.34	± 7.88	46.10	± 11.28	10.16	± 2.80	4.01	± 1.47	0.09	± 0.00	11.52	± 0.16
IV	1200	3	240.06	± 94.81	20.19	± 7.35	33.67	± 11.00	9.26	± 3.75	3.82	± 1.53	0.09	± 0.00	11.57	± 0.49
IV	2000	2	145.78	± 30.68	12.45	± 1.78	24.21	± 0.08	5.79	± 0.38	2.28	± 0.49	0.09	± 0.01	11.60	± 0.81
IV	3000	3	306.36	± 59.27	29.40	± 6.26	60.34	± 8.56	13.90	± 2.09	4.80	± 0.92	0.10	± 0.00	10.49	± 0.36
V	400	3	165.41	± 49.98	17.59	± 6.08	21.17	± 4.02	7.55	± 3.25	2.48	± 0.73	0.10	± 0.00	9.65	± 0.44
V	600	3	343.69	± 68.00	33.16	± 8.20	36.14	± 12.60	14.73	± 5.09	5.26	± 1.04	0.09	± 0.01	10.73	± 0.75
V	800	3	226.97	± 44.46	24.56	± 5.51	34.09	± 9.14	12.61	± 3.12	3.45	± 0.70	0.11	± 0.00	9.37	± 0.31
V	1000	3	227.39	± 22.18	21.69	± 2.13	22.26	± 3.93	9.84	± 1.57	3.37	± 0.34	0.10	± 0.01	10.51	± 0.58
V	1200	4	283.52	± 47.16	25.24	± 3.50	33.66	± 2.44	12.98	± 1.77	4.30	± 0.73	0.09	± 0.01	11.12	± 0.75

Table S3: Resting metabolic rates (individual and mass normalized) for each $p\text{CO}_2$ condition of exposure at each stage of development. $n = 20$ for larval stages I, II, III and $n = 6$ for postlarvae (stage IV) and juveniles (stage V).

Stage	$p\text{CO}_2$	Resting Metabolic Rate ($\mu\text{mol O}_2 \text{ h}^{-1}$)		Resting Metabolic Rate (Mass Normalized) ($\mu\text{mol O}_2 \text{ g}^{-1}\text{WBM h}^{-1}$)	
		Mean	SE	Mean	SE
I	400	0.13	± 0.01	17.81	± 1.32
I	600	0.16	± 0.01	21.90	± 0.98
I	800	0.15	± 0.01	19.90	± 1.59
I	1000	0.15	± 0.01	16.93	± 1.41
I	1200	0.15	± 0.01	19.90	± 1.44
I	2000	0.14	± 0.01	19.64	± 1.33
I	3000	0.13	± 0.01	18.00	± 1.99
II	400	0.19	± 0.02	17.08	± 2.11
II	600	0.16	± 0.01	15.50	± 0.89
II	800	0.17	± 0.02	15.95	± 1.39
II	1000	0.17	± 0.02	15.41	± 1.96
II	1200	0.18	± 0.01	17.94	± 1.11
II	2000	0.24	± 0.10	16.50	± 3.43
II	3000	0.20	± 0.02	18.96	± 1.66
III	400	0.17	± 0.02	11.22	± 1.30
III	600	0.18	± 0.02	11.09	± 1.22
III	800	0.32	± 0.02	18.29	± 1.01
III	1000	0.16	± 0.02	10.70	± 1.69
III	1200	0.28	± 0.02	16.49	± 1.02
III	2000	0.32	± 0.03	18.04	± 1.06
III	3000	0.31	± 0.02	18.49	± 1.22
IV	400	0.21	± 0.02	6.40	± 0.67
IV	600	0.62	± 0.11	18.49	± 1.87
IV	800	0.23	± 0.04	6.90	± 1.23
IV	1000	0.35	± 0.05	12.87	± 1.56
IV	1200	0.56	± 0.10	18.48	± 3.05
IV	2000	0.46	± 0.03	14.87	± 1.45
IV	3000	0.28	± 0.03	8.96	± 1.06
V	400	0.63	± 0.14	10.94	± 2.14
V	600	0.68	± 0.06	12.03	± 0.93
V	800	0.88	± 0.14	14.24	± 2.19
V	1000	0.80	± 0.09	12.80	± 1.54
V	1200	0.73	± 0.09	13.17	± 1.32

Table S4: Models testing the responses of life-history and physiological traits to $p\text{CO}_2$ and stage (+ covariate when needed). AIC, R^2 and adjusted R^2 are given for each equation. Bold R^2 shows the best fitted model based on AIC selection for each trait, following the rule of parsimony when AIC differ for less than a value of 2: i.e. when AIC are comparable the simpler model was consider as the best-fit model.

	Linear lm(days~covariate + pCO2*stage		Logarithmic lm(days~ covariate + log(pCO2)*stage		Polynomial (2 nd degree) lm(days~ covariate + poly(pCO2,2)*stage		Polynomial (3 rd degree) lm(days~ covariate + poly(pCO2,3)*stage	
	AIC	R ² (R ² adjusted)	AIC	R ² (R ² adjusted)	AIC	R ² (R ² adjusted)	AIC	R ² (R ² adjusted)
Developmental time	1011.82	0.126 (0.113)	1016.10	0.108 (0.094)	1009.99	0.152 (0.130)	1011.52	0.162 (0.131)
Morphometrics								
Total length (Lt)	995.84	0.847 (0.843)	994.95	0.847 (0.844)	995.18	0.850 (0.845)	1000.00	0.852 (0.845)
ceph/Lt	-1975.61	0.475 (0.464)	-1975.11	0.475 (0.464)	-1972.90	0.484 (0.467)	-1974.07	0.497 (0.474)
abd/Lt	-1909.59	0.194 (0.177)	-1911.81	0.198 (0.181)	-1908.69	0.211 (0.185)	-1901.40	0.216 (0.180)
ceph/abd	-712.68	0.384 (0.371)	-712.08	0.383 (0.370)	-707.45	0.390 (0.370)	-705.46	0.401 (0.374)
Rostrum	15.47	0.501 (0.489)	17.73	0.498 (0.487)	16.70	0.511 (0.494)	17.22	0.522 (0.498)
Cephalothorax	-95.18	0.925 (0.924)	-94.43	0.925 (0.923)	-94.80	0.927 (0.924)	-96.56	0.929 (0.925)
Abdomen	-15.92	0.875 (0.872)	-19.39	0.876 (0.873)	-18.93	0.878 (0.874)	-11.69	0.879 (0.873)
Tail	-86.87	0.739 (0.733)	-89.67	0.741 (0.735)	-81.39	0.742 (0.732)	-75.28	0.744 (0.732)
log(Claw)	-373.78	0.918 (0.916)	-374.73	0.918 (0.916)	-367.17	0.919 (0.916)	-364.47	0.920 (0.916)
Mineralisation								
log[Ca ²⁺]	201.30	0.476 (0.421)	202.01	0.472 (0.417)	209.73	0.483 (0.397)	216.15	0.501 (0.383)
log[Mg ²⁺]	166.35	0.225 (0.143)	164.97	0.235 (0.154)	172.14	0.255 (0.131)	176.70	0.292 (0.126)
log[Na ⁺]	150.72	0.575 (0.529)	152.26	0.568 (0.523)	156.84	0.590 (0.521)	161.83	0.609 (0.516)
log[K ⁺]	170.01	0.564 (0.518)	171.66	0.557 (0.510)	174.36	0.586 (0.518)	175.12	0.621 (0.532)
log[Sr ⁺]	208.42	0.451 (0.393)	209.07	0.448 (0.390)	216.90	0.459 (0.369)	223.14	0.478 (0.355)
[Mg ²⁺]:[Ca ²⁺]	-249.57	0.6502 (0.613)	-255.70	0.6701 (0.635)	-263.28	0.7209 (0.674)	-258.05	0.7333 (0.670)
Feeding rate	392.44	0.133 (0.069)	392.21	0.137 (0.073)	394.88	0.156 (0.059)		0.308 (0.197)
Resting metabolic rate (MO ₂)	-751.02	0.746 (0.740)	-750.84	0.746 (0.740)	-756.62	0.755 (0.746)	-752.69	0.759 (0.746)

Table S5 ANOVA and post-hoc Tukey HSD results assessing the effects of ocean acidification ($p\text{CO}_2$ concentration groups: 1 – 400 μatm ; 2 – 600 μatm ; 3 – 800 μatm ; 4 – 1000 μatm ; 5 – 1200 μatm ; 6 – 2000 μatm ; 7 – 3000 μatm) in stage I larvae. Only significant metabolites are included in the table.

Metabolite	Fvalue	p value	-log10(p)	FDR	Tukey's HSD
C20.1	10.496	2.30E-07	6.6391	1.29E-05	2-1; 3-1; 5-1; 6-1; 7-1; 6-4; 7-4
C11.0	9.4508	8.37E-07	6.0774	2.34E-05	4-1; 5-1; 6-1; 7-1; 5-3; 6-3; 7-3
C17.1	8.8354	1.85E-06	5.7323	3.46E-05	2-1; 3-1; 4-1; 5-1; 6-1; 7-1
C20.5	7.4864	1.16E-05	4.9359	0.00016225	2-1; 3-1; 4-1; 5-1; 6-1; 7-1
Betaine	7.11	1.98E-05	4.7033	0.00019532	4-1; 5-1; 6-1; 7-1; 4-2; 5-2; 6-2; 7-2
Phospho.L.Arginine	7.0716	2.09E-05	4.6793	0.00019532	3-1; 4-1; 5-1; 6-1; 7-1; 6-2
C14.0	6.9389	2.54E-05	4.5959	0.00019974	2-1; 3-1; 4-1; 5-1; 6-1; 7-1
C22.6	6.8358	2.95E-05	4.5308	0.00019974	2-1; 3-1; 4-1; 5-1; 6-1; 7-1
C15.0	6.777	3.21E-05	4.4935	0.00019974	2-1; 3-1; 4-1; 5-1; 6-1; 7-1
C8.0	6.5098	4.76E-05	4.3223	0.00026659	2-1; 3-1; 4-1; 5-1; 6-1; 7-1
C20.4	5.7678	0.0001	3.8338	0.0007045	2-1; 3-1; 5-1; 6-1
C20.2	5.7011	0.0002	3.7889	0.0007045	2-1; 3-1; 4-1; 5-1; 6-1; 7-1
C15.1	5.6974	0.0002	3.7864	0.0007045	2-1; 4-1; 5-1; 6-1; 7-1; 5-3
Succinate	5.4579	0.0002	3.6238	0.00095127	3-1; 4-1; 5-1; 6-1; 5-2
ATP	5.34	0.0003	3.5429	0.0010269	3-1; 5-3; 6-3; 7-3
C18.3	5.3248	0.0003	3.5325	0.0010269	2-1; 3-1; 4-1; 6-1; 7-1
C10.0	4.8863	0.0006	3.2272	0.0019523	2-1; 3-1; 4-1; 5-1; 6-1; 7-1
C20.3	4.6966	0.0008	3.0929	0.0025121	2-1; 3-1; 5-1; 6-1; 7-1
C12.0	4.6195	0.0009	3.0379	0.0027011	3-1; 4-1; 5-1; 6-1; 7-1
C16.0	4.4369	0.0012	2.9069	0.0034693	4-1; 5-1; 5-3
a.ketoglutaric.acid	4.2124	0.0018	2.7442	0.0048054	2-1; 4-1
Valine	3.8722	0.0032	2.4944	0.0081539	5-3; 5-4; 6-5; 7-5
C18.1	3.8086	0.0036	2.4473	0.0086255	2-1; 3-1; 4-1; 5-1; 6-1; 7-1
NAD	3.7883	0.0037	2.4322	0.0086255	3-1; 6-1; 7-1
AMP	3.5234	0.0058	2.2344	0.013056	2-1; 4-1; 6-1; 7-1
C22.1	3.4618	0.0065	2.1881	0.013967	3-1; 4-1; 7-1
C18.2	3.4285	0.0069	2.163	0.014249	2-1; 6-1; 7-1
Malate	3.3963	0.0073	2.1388	0.01453	2-1; 3-1
C13.0	3.1207	0.0117	1.93	0.022686	2-1; 3-1; 4-1; 5-1; 7-1
8.Oxo.2.dexyguanosine	2.8749	0.0181	1.7426	0.033767	2-1; 3-1; 4-1; 5-1; 6-1; 7-1

Cystine	2.8282	0.0196	1.7068	0.035482	6-1; 7-1
a.Glycerophosphate	2.7281	0.0234	1.6302	0.04101	5-1; 7-1

Table S6. ANOVA and Tukey HSD post-hoc results assessing the effects of ocean acidification ($p\text{CO}_2$ concentration groups: 1 – 400 μatm ; 2 – 600 μatm ; 3 – 800 μatm ; 4 – 1000 μatm ; 5 – 1200 μatm ; 6 – 2000 μatm ; 7 – 3000 μatm) in stage II larvae. Only significant metabolites are included in the table.

Metabolite	Fvalue	p value	-log10(p)	FDR	Tukey's HSD
C20.5	8.993	3.5109E-6	5.4546	1.615E-4	7-1; 7-2; 7-3; 7-4; 7-5; 7-6
C18.1	6.4646	8.5935E-5	4.0658	0.0016617	7-1; 7-2; 7-3; 7-4; 7-5; 7-6
C20.4	6.2955	1.0837E-4	3.9651	0.0016617	7-1; 7-2; 7-3; 7-4; 7-5; 7-6
C18.2	5.9621	1.7242E-4	3.7634	0.0019828	7-1; 7-2; 7-3; 7-4; 7-5; 7-6
a.ketoglutaric.acid	5.5877	2.9386E-4	3.5319	0.002465	7-1; 7-2; 7-3; 7-4; 7-5; 7-6
C17.0	5.4259	3.7146E-4	3.4301	0.002465	7-1; 7-2; 7-3; 7-4; 7-5; 7-6
C16.1	5.4191	3.7511E-4	3.4258	0.002465	7-1; 7-2; 7-3; 7-4; 7-5; 7-6
Malate	5.1605	5.4833E-4	3.261	0.0030892	7-1; 7-2; 7-3; 7-4; 7-5; 7-6
C20.3	5.0851	6.1321E-4	3.2124	0.0030892	7-1; 7-3; 7-5; 7-6
C18.3	5.0241	6.7157E-4	3.1729	0.0030892	7-1; 7-2; 7-3; 7-4; 7-5; 7-6
Fumarate	4.2011	0.0023665	2.6259	0.0098963	7-2; 7-3; 7-5; 7-6
C20.2	4.0048	0.0032256	2.4914	0.012365	7-1; 7-2; 7-3; 7-4; 7-6
Alanine	3.8937	0.003849	2.4146	0.013088	5-1
Lactate	3.8723	0.0039832	2.3998	0.013088	5-3; 5-4
Sarcosine	3.3993	0.0085625	2.0674	0.026258	no significant pairwise comparisor
C22.6	3.303	0.010027	1.9988	0.028828	7-1; 7-2; 7-3; 7-4; 7-6
Phospho.L.Arginine	3.2648	0.010678	1.9715	0.028893	7-3
Methionine	2.9344	0.018472	1.7335	0.047207	3-1
a.Glycerophosphate	2.8748	0.020406	1.6902	0.049405	7-2; 7-5

Table S7: Physico-chemical parameters (mean \pm SE) of the different $p\text{CO}_2$ treatments for larval setup ($n_{\text{kreisels}} = 4$ per $p\text{CO}_2$ condition) and juvenile setup ($n_{\text{tanks}} = 3$ per $p\text{CO}_2$ condition). Seawater temperature, salinity, oxygen content, pH_T (pH on the total scale) and total alkalinity (A_T) were measured whereas the other parameters of the carbonate system were calculated with CO2sys software (Lewis & Wallace, 1998). $p\text{CO}_2$: CO_2 partial pressure; DIC: dissolved inorganic carbon; HCO_3^- : bicarbonates concentration; CO_3^{2-} : carbonates concentration; Ω_{Ca} : saturation state of seawater with respect to calcite and Ω_{Ar} : saturation state of seawater with respect to aragonite.

	“Larval” setup (28 kreisels) from 1 st to 18 th of July 2016																				
	400 μatm			600 μatm			800 μatm			1000 μatm			1200 μatm			2000 μatm			3000 μatm		
	n=59 except for salinity & A _T (n= 6)			n=4 except for salinity & A _T (n= 6)			n=68 except for salinity & A _T (n= 6)			n=68 except for salinity & A _T (n= 6)			n=68 except for salinity & A _T (n= 6)			n=56 except for salinity & A _T (n= 6)			n=51 except for salinity & A _T (n= 6)		
Temperature (°C)	17.97	±	0.03	17.95	±	0.04	17.97	±	0.03	17.95	±	0.04	17.88	±	0.05	17.96	±	0.04	17.97	±	0.03
Salinity	31.28	±	0.03	31.37	±	0.10	31.42	±	0.08	31.40	±	0.08	31.42	±	0.06	31.37	±	0.06	31.33	±	0.06
Oxygen (% sat)	99.70	±	1.04	96.89	±	1.80	97.44	±	1.66	98.17	±	1.09	99.24	±	1.03	97.98	±	1.24	98.20	±	1.22
pH _T	7.99	±	0.00	7.85	±	0.01	7.78	±	0.01	7.72	±	0.01	7.62	±	0.01	7.38	±	0.01	7.22	±	0.01
A _T (μEq kg ⁻¹)	2098.27	±	3.71	2097.75	±	5.81	2100.07	±	4.70	2092.04	±	3.04	2098.65	±	6.96	2107.73	±	4.71	2100.10	±	8.37
DIC (μmol kg ⁻¹)	1922.37	±	1.18	1983.51	±	4.03	2007.84	±	3.34	2013.48	±	3.67	2054.43	±	4.11	2134.02	±	3.56	2167.89	±	4.76
pCO ₂ (μatm)	437.35	±	3.79	651.68	±	21.51	778.03	±	18.92	897.62	±	33.96	1155.76	±	36.47	2062.23	±	63.16	2974.21	±	75.12
HCO ₃ ⁻ (μmol kg ⁻¹)	1773.58	±	1.85	1858.46	±	5.40	1892.84	±	4.19	1903.57	±	4.26	1950.58	±	4.15	2023.85	±	2.43	2037.57	±	3.97
CO ₃ ²⁻ (μmol kg ⁻¹)	133.54	±	0.83	102.32	±	2.21	87.87	±	1.63	78.61	±	1.70	63.47	±	1.43	37.90	±	0.95	26.59	±	0.65
Ω _{Ca}	3.26	±	0.02	2.50	±	0.05	2.15	±	0.04	1.92	±	0.04	1.55	±	0.03	0.93	±	0.02	0.65	±	0.02
Ω _{ar}	2.09	±	0.01	1.60	±	0.03	1.38	±	0.03	1.23	±	0.03	0.99	±	0.02	0.59	±	0.01	0.42	±	0.01
	“Juvenile setup” (21 tanks) from 18 th of July to 21 st of August 2016																				
	400 μatm			600 μatm			800 μatm			1000 μatm			1200 μatm			2000 μatm			3000 μatm		
	n=105 except for salinity, A _T and DIC(n=6)			n=105 except for salinity & A _T (n= 6)			n=103 except for salinity & A _T (n= 6)			n=94 except for salinity & A _T (n= 6)			n=135 except for salinity & A _T (n= 6)			n=105 except for salinity & A _T (n= 6)			n=96 except for salinity & A _T (n= 6)		
Temperature (°C)	17.92	±	0.02	18.06	±	0.13	18.10	±	0.10	18.03	±	0.12	17.98	±	0.12	17.96	±	0.01	17.96	±	0.02
Salinity	31.47	±	0.12	31.50	±	0.12	31.47	±	0.12	31.52	±	0.08	31.52	±	0.11	31.55	±	0.06	31.58	±	0.08
Oxygen (% sat)	98.62	±	0.79	99.14	±	1.12	99.41	±	1.11	110.49	±	11.06	99.15	±	0.70	108.81	±	9.39	98.45	±	0.83
pH _T	7.97	±	0.00	7.88	±	0.01	7.79	±	0.01	7.70	±	0.01	7.66	±	0.01	7.36	±	0.01	7.14	±	0.01
A _T (μmol kg ⁻¹)	2131.20	±	5.33	2132.32	±	3.67	2133.43	±	4.52	2135.74	±	6.16	2133.24	±	4.43	2132.37	±	4.98	2136.44	±	5.15
DIC (μmol kg ⁻¹)	1959.24	±	0.97	1992.08	±	2.17	2024.90	±	2.92	2054.68	±	3.30	2067.09	±	2.35	2154.74	±	3.39	2231.76	±	3.92
pCO ₂ (μatm)	473.87	±	2.61	601.79	±	14.32	773.79	±	25.52	968.56	±	32.87	1061.44	±	22.52	2201.55	±	68.32	3714.80	±	102.65
HCO ₃ ⁻ (μmol kg ⁻¹)	1814.35	±	1.16	1861.42	±	2.98	1905.74	±	3.75	1943.43	±	4.12	1959.96	±	2.94	2040.49	±	2.02	2079.37	±	1.28
CO ₃ ²⁻ (μmol kg ⁻¹)	128.34	±	0.59	109.84	±	1.29	92.32	±	1.67	77.91	±	1.89	70.06	±	1.32	37.43	±	0.90	22.61	±	0.50
Ω _{Ca}	3.13	±	0.01	2.68	±	0.03	2.26	±	0.04	1.90	±	0.05	1.71	±	0.03	0.92	±	0.02	0.55	±	0.01
Ω _{ar}	2.01	±	0.01	1.72	±	0.02	1.45	±	0.03	1.22	±	0.03	1.09	±	0.02	0.59	±	0.01	0.35	±	0.01

Figure S1. Metabolomic fingerprinting stages III to IV. Metabolome differences between $p\text{CO}_2$ groups in lobster larval stages III, IV and V **(a)** PCA 2D score plot with 95% confidence intervals for stage III, **(b)** PCA 2D score plot with 95% confidence intervals for stage IV, **(c)** PCA 2D score plot with 95 % confidence intervals for stage V, **(d)** PLS-DA scores plot with 95% confidence intervals for stage V. Model validation was calculated by the prediction accuracy during training test statistic with 1000 permutations, $p = 0.016$, **(e)** PLS-DA Variable Importance in Projection scores (VIP > 1 for significance). None of the metabolites were significant in the univariate ANOVA (FDR 0.05). $p\text{CO}_2$ groups: 1 – 400 μatm , 2- 600 μatm , 3 – 800 μatm , 4 – 1000 μatm , 5 – 1200 μatm , 6 – 2000 μatm , 7 – 3000 μatm). Group 6 and 7 are lacking from stage V analysis due to mortality levels.

