

Supplementary Materials

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Supplementary Table S1. Analysis of variance (ANOVA) for the effects of $p\text{CO}_2$ (400 and 1,000 μatm) and temperatures (15, 19, 23, 27, and 30 or 31°C) on maximum quantum yield (F_v/F_m) of *Alexandrium affine* and *A. pacificum*

	df	MS	F	p-value
<i>A. affine</i>				
$p\text{CO}_2$	1	0.002	0.255	0.615
Temperature	4	0.110	14.975	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.004	0.611	0.656
Error	80	0.007		
<i>A. pacificum</i>				
$p\text{CO}_2$	1	0.084	11.816	0.001
Temperature	4	0.065	9.151	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.002	0.339	0.851
Error	80	0.007		

Supplementary Table S2. Analysis of variance (ANOVA) for the effects of $p\text{CO}_2$ (400 and 1,000 μatm) and temperatures (15, 19, 23, 27, and 30 or 31°C) on specific growth rate (d^{-1}) of *Alexandrium affine* and *A. pacificum*

	df	MS	F	p-value
<i>A. affine</i>				
$p\text{CO}_2$	1	0.211	15.994	0.001
Temperature	4	1.056	79.880	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.004	0.318	0.865
Error	80	0.013		
<i>A. pacificum</i>				
$p\text{CO}_2$	1	0.005	0.482	0.489
Temperature	4	0.519	46.743	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.017	1.529	0.202
Error	80	0.011		

Supplementary Table S3. Analysis of variance (ANOVA) for the effects of $p\text{CO}_2$ (400 and 1,000 μatm) and temperatures (15, 19, 23, 27, and 30 or 31°C) on percentage of chain formation in *Alexandrium affine* and *A. pacificum*

	df	MS	F	p-value
<i>A. affine</i>				
$p\text{CO}_2$	1	0.063	4.244	0.043
Temperature	4	0.665	44.602	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.008	0.568	0.686
Error	80	0.015		
<i>A. pacificum</i>				
$p\text{CO}_2$	1	0.056	4.198	0.044
Temperature	4	0.841	62.545	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.027	2.022	0.099
Error	80	0.013		

Supplementary Table S4. Two-way analysis of variance (ANOVA) for the effects of $p\text{CO}_2$ (400 and 1,000 μatm) and temperatures (15, 19, 23, 27, and 31°C) on chain-length fractionation of *Alexandrium affine*

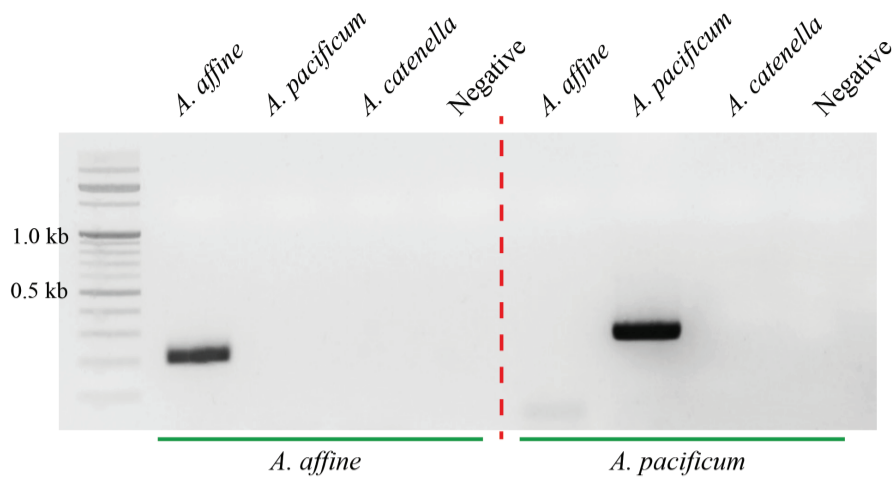
	df	MS	F	p-value
Short chain-length fractionation				
$p\text{CO}_2$	1	0.018	0.882	0.350
Temperature	4	0.217	10.698	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.007	0.346	0.846
Error	80	0.02		
Middle chain-length fractionation				
$p\text{CO}_2$	1	0.457	20.204	0.001
Temperature	4	0.446	19.724	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.008	0.360	0.751
Error	80	0.023		
Long chain-length fractionation				
$p\text{CO}_2$	1	0.013	1.194	0.278
Temperature	4	0.096	8.526	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.009	0.782	0.540
Error	80	0.011		

The CF was classified into four categories: single cells, short chain-length (<4 cells chain⁻¹), middle chain-length (4–8 cells chain⁻¹), and long chain-length (>8 cells chain⁻¹) (n = 9).

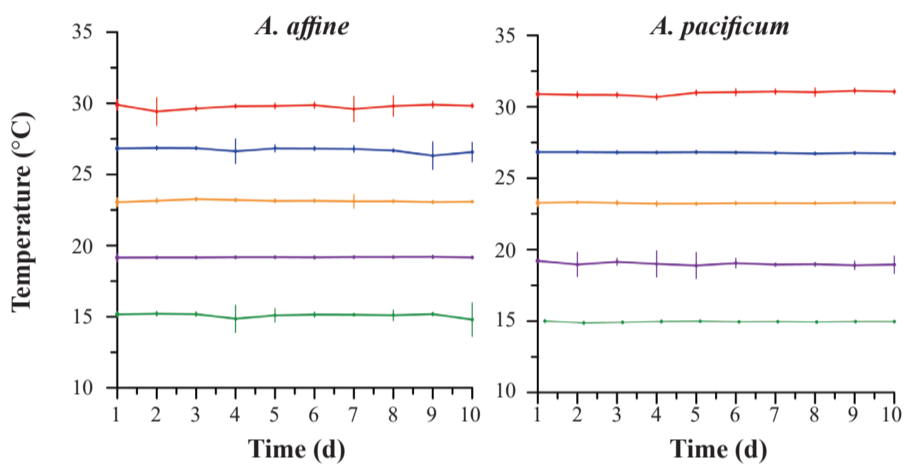
Supplementary Table S5. Two-way analysis of variance (ANOVA) for the effects of $p\text{CO}_2$ (400 and 1,000 μatm) and temperatures (15, 19, 23, 27, and 30°C) on chain-length fractionation of *Alexandrium pacificum*

	df	MS	F	p-value
Short chain-length fractionation				
$p\text{CO}_2$	1	0.033	2.599	0.111
Temperature	4	0.740	59.141	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.027	2.120	0.086
Error	80	0.013		
Middle chain-length fractionation				
$p\text{CO}_2$	1	0.015	5.897	0.017
Temperature	4	0.028	11.026	0.001
$p\text{CO}_2 \times \text{Temperature}$	4	0.004	1.7	0.158
Error	80	0.003		

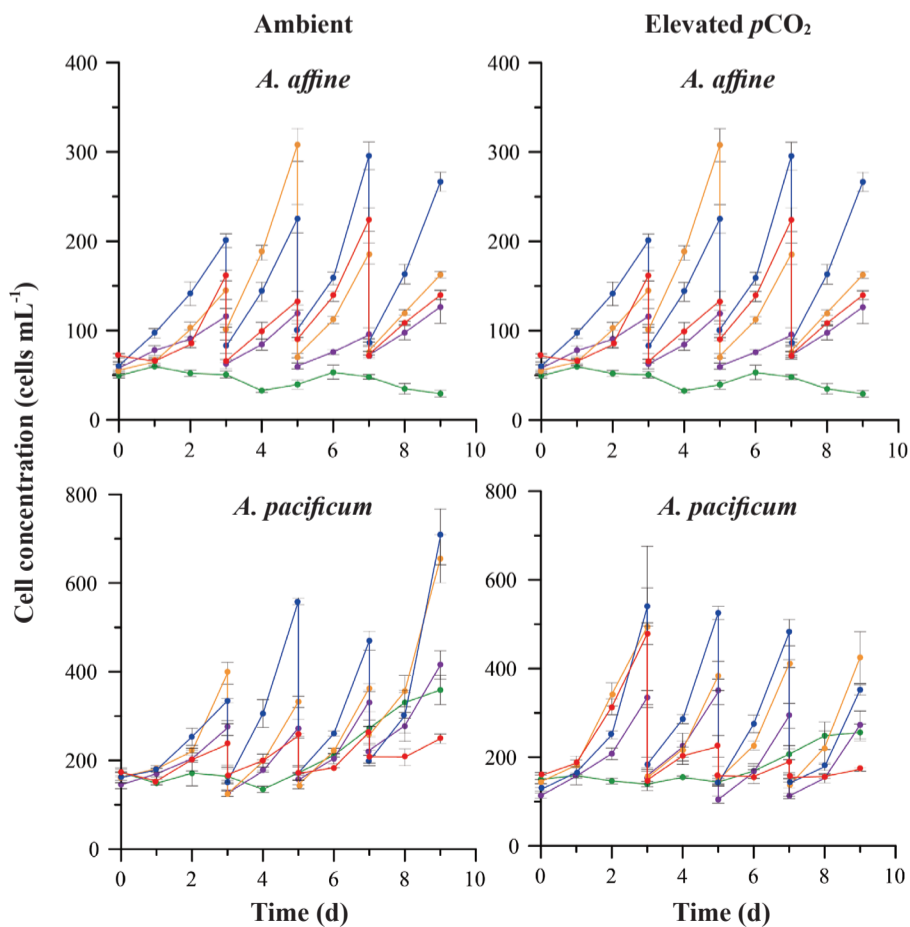
The CF was classified into four categories: single cells, short chain-length (<4 cells chain⁻¹), middle chain-length (4–8 cells chain⁻¹), and long chain-length (>8 cells chain⁻¹) (n = 9).



Supplementary Fig. S1. Genotyping *Alexandrium affine* (left) and *A. pacificum* (right) with specific primers. Internal transcribed spacer (ITS) targeted amplicons (206 bp for *A. affine* and 252 bp for *A. pacificum*) were specifically shown without no PCR product to other species.



Supplementary Fig. S2. Temperature of cultures during the thermal performance experiment of *Alexandrium affine* and *A. pacificum* (green, 15°C; purple, 19°C; orange, 23°C; blue, 27°C; red, 30°C).



Supplementary Fig. S3. Cell abundance (cells mL⁻¹) at various assay temperatures for *Alexandrium affine* and *A. pacificum* in ambient (left panels, A & C) and elevated pCO₂ (right panels, B & D) conditions (green, 15°C; purple, 19°C; orange, 23°C; blue, 27°C; red, 31°C).