

Supplementary information for:

Inorganic carbon physiology underpins macroalgal responses to elevated CO₂

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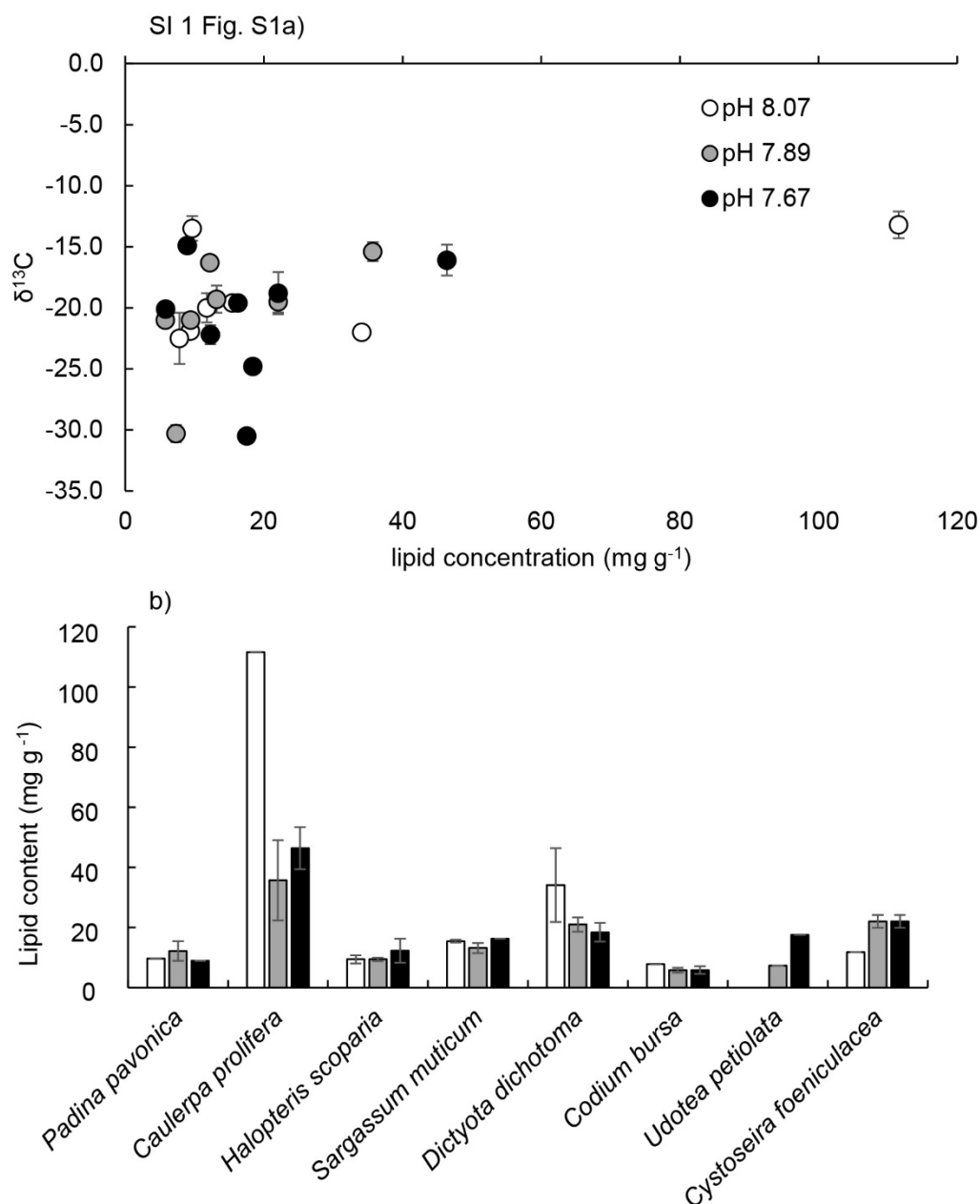
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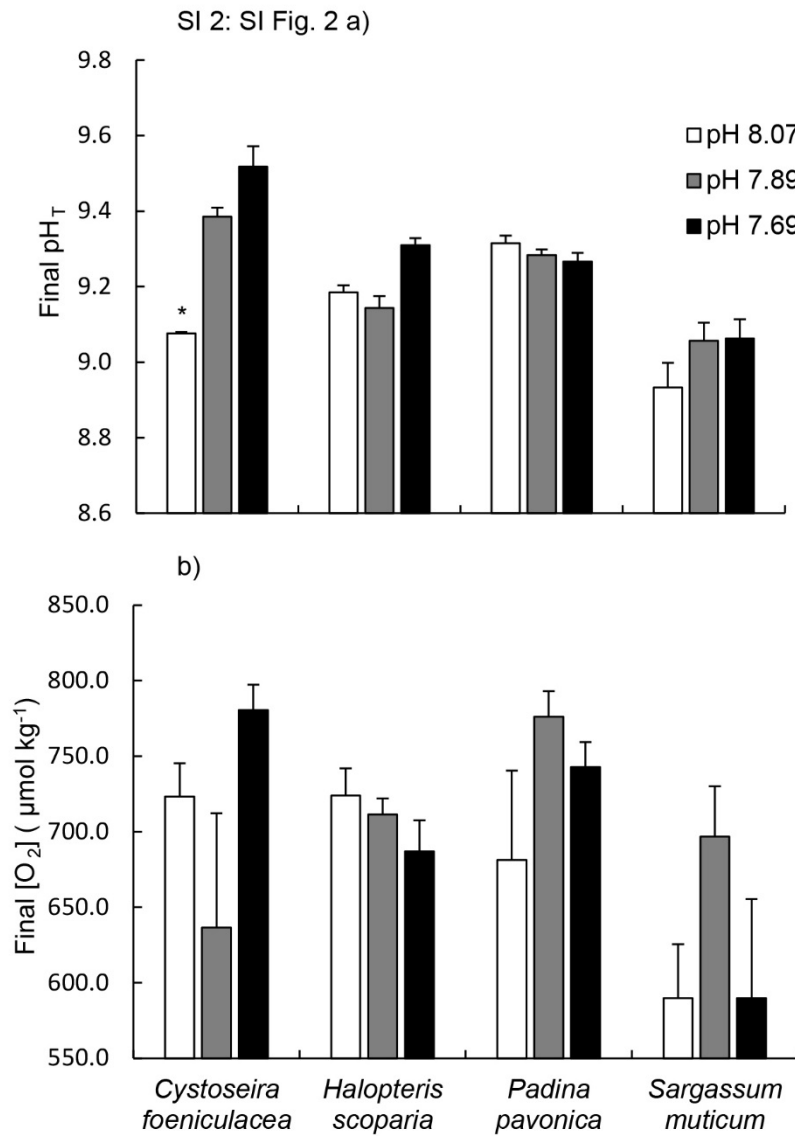
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SI 1, SI Fig. 1: a) Concentrations of lipids plotted against $\delta^{13}\text{C}$ and b) species' mean lipid content of macroalgae collected at locations with differing seawater pH at a CO₂ seep from Vulcano, Italy, showing no relationship between lipid concentration and $\delta^{13}\text{C}$. $n = 3 - 4$. Mean $\pm$ one standard error.



SI 2, SI Fig. 2: a) pH and b) O₂ compensation points of the four most abundant macroalgal species collected at locations with differing seawater pH at a CO₂ seep at Vulcano, Italy, demonstrating only for *Cystoseira foeniculacea* was there a significant difference between the pH compensation points between locations. $n = 3 - 4$. Mean $\pm$ one standard error.

SI 3: List of species from Porzio et al. ¹ and Baggini et al. ², and the $\delta^{13}\text{C}$ value of that species from literature and its source. When $\delta^{13}\text{C}$ for a particular species could not be found, but it could be found for another species in the genus, the other species $\delta^{13}\text{C}$ was used: these are marked with *.

Species	$\delta^{13}\text{C}$ value from literature	Source of $\delta^{13}\text{C}$	Physiological group
<i>Acrothamnion preissii</i>	Unknown		Unknown
<i>Aglaothamnion bipinnatum</i>	-28.96*	3	Non-CCM
<i>Aglaothamnion diaphanum</i>	-28.96*	3	Non-CCM
<i>Amphiroa criptarthrodia</i>	-13.70 to -13.78*	4,5	Calcareous red
<i>Amphiroa rigida</i>	-13.70 to -13.78*	4,5	Calcareous red
<i>Amphiroa</i> sp.	-13.70 to -13.78*	4,5	Calcareous red
<i>Anotrichium tenue</i>	-30.00 to 31.37*	6	Non-CCM
<i>Antithamnion cruciatum</i>	-27.77 to -27.81*	7	Unknown
<i>Antithamnion</i> sp.	-27.77 to -27.81*	7	Unknown
<i>Bryopsis plumosa</i>	-19.0 to -19.35	4,8	CCM
<i>Caulerpa racemosa</i>	-15.20 to -17.50	This study	CCM
<i>Centroceras clavulatum</i>	Unknown		Unknown
<i>Ceramium circinatum</i>	-12.39 to -21.68*	9	CCM
<i>Ceramium codii</i>	-12.39 to -21.68*	9	CCM
<i>Ceramium diaphanum</i>	-12.39 to -21.68*	9	CCM
<i>Ceramium flaccidum</i>	-12.39 to -21.68*	9	CCM
<i>Chaetomorpha linum</i>	-14.73 to -21.80	3,10	CCM
<i>Champia parvula</i>	-20.33 to -22.82	7	CCM
<i>Chondracanthus acicularis</i>	-11.10	11	CCM
<i>Chondrophycus papillosus</i>	Unknown		Unknown
<i>Choreonema thuretii</i>	Unknown		Calcareous red
<i>Cladophora dalmatica</i>	-10.83 to -35.57*	3,12	Unknown
<i>Cladophora flexuosa</i>	-10.83 to -35.57*	3,12	Unknown
<i>Cladophora laetevirens</i>	-15.64	11	CCM
<i>Cladophora pellucida</i>	-10.83 to -35.57*	3,12	Unknown
<i>Cladophora prolifera</i>	-17.50	13	CCM
<i>Cladophora rupestris</i>	-13.33 to -21.30	8,14	CCM
<i>Cladophora sericea</i>	-16.66	8	CCM
<i>Cladophora socialis</i>	-10.83 to -35.57*	3,12	Unknown
<i>Cladophora</i> sp.	-10.83 to -35.57*	3,12	Unknown
<i>Cladostephus spongiosus</i>	-16.96 to -21.44	3	CCM
<i>Contarinia squamariae</i>	Unknown		Unknown
<i>Corallina elongata</i>	-19.70 to -23.60	14,15	Calcareous red
<i>Corallina officinalis</i>	-7.45 to -15.81	3,11	Calcareous red
<i>Corallina</i> sp.	-5.69 to -23.60*	3,15	Calcareous red
<i>Corallinaceae</i>	-5.69 to -23.60*	3,15	Calcareous red
<i>Crouania attenuata</i>	Unknown		Unknown
<i>Cystoseira amentacea</i>	-24.6	This study	CCM
<i>Cystoseira corniculata</i>	-12.60 to -24.60*	This study	CCM
<i>Dasya baillouviana</i>	-15.85 to -34.29*	4,16	Unknown

<i>Dasya hutchinsiae</i>	-15.85 to -34.29*	4,16	Unknown
<i>Dasya rigidula</i>	-15.85 to -34.29*	4,16	Unknown
<i>Dictyopteris polypodioides</i>	-16.12 to -19.8	This study, ¹¹	CCM
<i>Dictyota dichotoma</i>	-15.7 to -24.8	This study	CCM
<i>Dictyota dichotoma</i> var. <i>intricata</i>	-18.58	¹¹	CCM
<i>Dictyota spiralis</i>	-15.06 to -24.8*	This study, ³	CCM
<i>Dictyota</i> sp.	-15.06 to -24.8*	This study, ³	CCM
<i>Falkenbergia</i> sp.	Unknown		Unknown
<i>Feldmannia irregularis</i>	-16.5*	¹⁷	CCM
<i>Flabellia petiolata</i> (<i>Udotea petiolata</i>)	-29.60 to -30.8	This study, ¹¹	Non-CCM
<i>Gelidiella pannosa</i>	-14.75*	⁴	CCM
<i>Gelidium bipectinatum</i>	-12.75 to 17.30*	^{11,18}	CCM
<i>Gelidium minusculum</i>	-12.75 to 17.30*	^{11,18}	CCM
<i>Griffithsia phyllamphora</i>	Unknown		Unknown
<i>Halimeda tuna</i>	-19.30	¹³	Calcareous green
<i>Halopteris filicina</i>	-20.10 to -22.2*	This study, ⁶	CCM
<i>Halopteris scoparia</i>	-20.07 to -22.2	This study, ¹³	CCM
<i>Herposiphonia secunda</i>	Unknown		Unknown
<i>Herposiphonia secunda</i> f. <i>tenella</i>	Unknown		Unknown
<i>Herposiphonia</i> sp.	Unknown		Unknown
<i>Heterosiphonia crispella</i>	-14.99 to -28.98*	³	Unknown
<i>Hildenbrandia rubra</i>	-18.04*	³	CCM
<i>Hydrolithon boreale</i>	-12.70*	⁵	Calcareous red
<i>Hydrolithon cruciatum</i>	-12.70*	⁵	Calcareous red
<i>Hydrolithon farinosum</i>	-12.70*	⁵	Calcareous red
<i>Jania rubens</i>	-12.57 to -23.69	^{3,11}	Calcareous red
<i>Laurencia obtusa</i>	-9.72 to -20.26*	^{3,9}	CCM
<i>Laurencia</i> sp.	-9.72 to -20.26*	^{3,9}	CCM
<i>Lithophyllum incrustans</i>	Unknown		Calcareous red
<i>Lithophyllum</i> sp.	Unknown		Calcareous red
<i>Lobophora variegata</i>	-11.96 to -17.55	^{3,9}	CCM
<i>Lophosiphonia cristata</i>	Unknown		Unknown
<i>Meredithia microphylla</i>	Unknown		Calcareous red
<i>Mesophyllum</i> sp.	Unknown		Calcareous red
<i>Monosporus pedicellatus</i>	Unknown		Unknown
<i>Neogoniolithon brassica-florida</i>	-12.40	⁵	Calcareous red
<i>Nitophyllum punctatum</i>	-30.55 to -33.59	^{3,9}	Non-CCM
<i>Osmundea truncata</i>	-16.31 to -17.23*	^{11,19}	CCM
<i>Padina pavonica</i>	-6.46 to -16.3	This study, ¹¹	Calcareous brown
<i>Parvocaulis parvulum</i>			Calcareous green
<i>Peyssonnelia armorica</i>	-9.77 to -32.71*	^{9,20}	Calcareous red
<i>Peyssonnelia bornetii</i>	-9.77 to -32.71*	^{9,20}	Calcareous red
<i>Peyssonnelia</i> cfr <i>rubra</i>	-9.77 to -32.71*	^{9,20}	Calcareous red

<i>Peyssonnelia dubyi</i>	-9.77 to -32.71*	9,20	Calcareous red
<i>Peyssonnelia polymorpha</i>	-9.77 to -32.71*	9,20	Calcareous red
<i>Peyssonnelia squamaria</i>	-9.77 to -32.71*	9,20	Calcareous red
<i>Phyllophora crispa</i>	-28.73 to -34.76	3,11	Non-CCM
<i>Phyllophora sicula</i>	-28.73 to -34.76*	3,11	Non-CCM
<i>Phymatolithon cfr lenormandii</i>	Unknown		Calcareous red
<i>Phymatolithon lenormandii</i>	Unknown		Calcareous red
<i>Pneophyllum fragile</i>	Unknown		Calcareous red
<i>Polysiphonia denudata</i>	-14.47 to -29.39*	3	Unknown
<i>Polysiphonia fibrata</i>	-14.47 to -29.39*	3	Unknown
<i>Polysiphonia scopulorum</i>	-14.47 to -29.39*	3	Unknown
<i>Pseudochlorodesmis furcellata</i>	Unknown		Unknown
<i>Pterocladia capillacea</i>	-14.50 to 20.21	11,21	CCM
<i>Ptilothamnion sphaericum</i>	Unknown		Unknown
<i>Sargassum vulgare</i>	-15.40 to -15.82	3,11	CCM
<i>Spermothamnion repens</i>	Unknown		Calcareous red
<i>Spermothamnion strictum</i>	Unknown		Calcareous red
<i>Sphacelaria cirrosa</i>	-17.85*	3	CCM
<i>Sphacelaria rigidula</i>	-17.85*	3	CCM
<i>Sphacelaria sp.</i>	-17.85*	3	CCM
<i>Sphacelaria tribuloides</i>	-17.85*	3	CCM
<i>Titanoderma pustulatum</i>	Unknown		Calcareous red
<i>Titanoderma sp.</i>	Unknown		Calcareous red
<i>Valonia utricularis</i>	-16.35	11	CCM

SI 4: Seawater carbonate chemistry and $\delta^{13}\text{C}$ of dissolved inorganic carbon (DIC) at locations from Boatta et al.²² pH_T , A_T (total alkalinity), DIC and $\delta^{13}\text{C}$ of DIC were measured, while the species of DIC were calculated from A_T and DIC. Units are $\mu\text{mol kg}^{-1}$ for all parameters except pH_T and $\delta^{13}\text{C}$ of DIC.

Site	pH_T	A_T	DIC	$[\text{CO}_2]$	$[\text{HCO}_3^-]$	$[\text{CO}_3^{2-}]$	$\delta^{13}\text{C}$ of DIC
S3	7.69 ($\pm$ 0.06)	2475 ($\pm$ 10)	2323 ($\pm$ 29)	30 ($\pm$ 7)	2164 ($\pm$ 44)	128 ($\pm$ 22)	-0.54 ($\pm$ 0.14)
S2	7.89 ($\pm$ 0.09)	2518 ($\pm$ 18)	2195 ($\pm$ 10)	14 ($\pm$ 1)	1959 ($\pm$ 25)	222 ($\pm$ 18)	0.54 ($\pm$ 0.04)
S1	8.04 ($\pm$ 0.02)	2516 ($\pm$ 11)	2170 ($\pm$ 10)	12 ($\pm$ 1)	1910 ($\pm$ 10)	248 ($\pm$ 8)	0.45 ($\pm$ 0.28)

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