The following supplement accompanies the article

Modelling kelp forest primary production using *in situ* photosynthesis, biomass and light measurements

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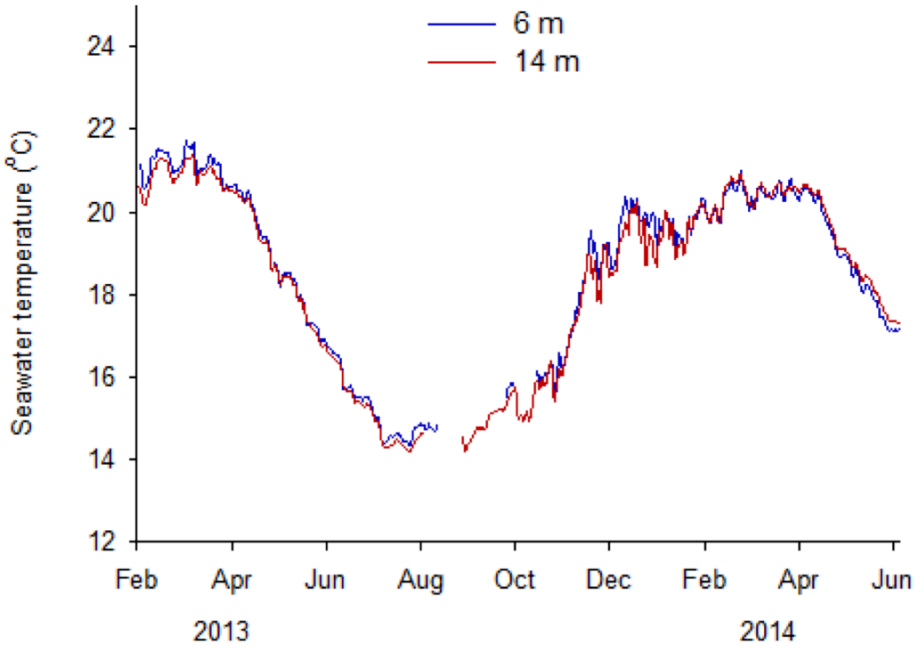

Figure S1. Average daily seawater temperature at the two sites where photosynthetic measurements were made during 2013. 6 m depth in Alphabet Bay and 14 m depth at North Reef. The two sites were 220 m apart on the west side of Goat Island, northeastern New Zealand. Data is from half hourly measurements from Onset Pendant Hobo loggers.

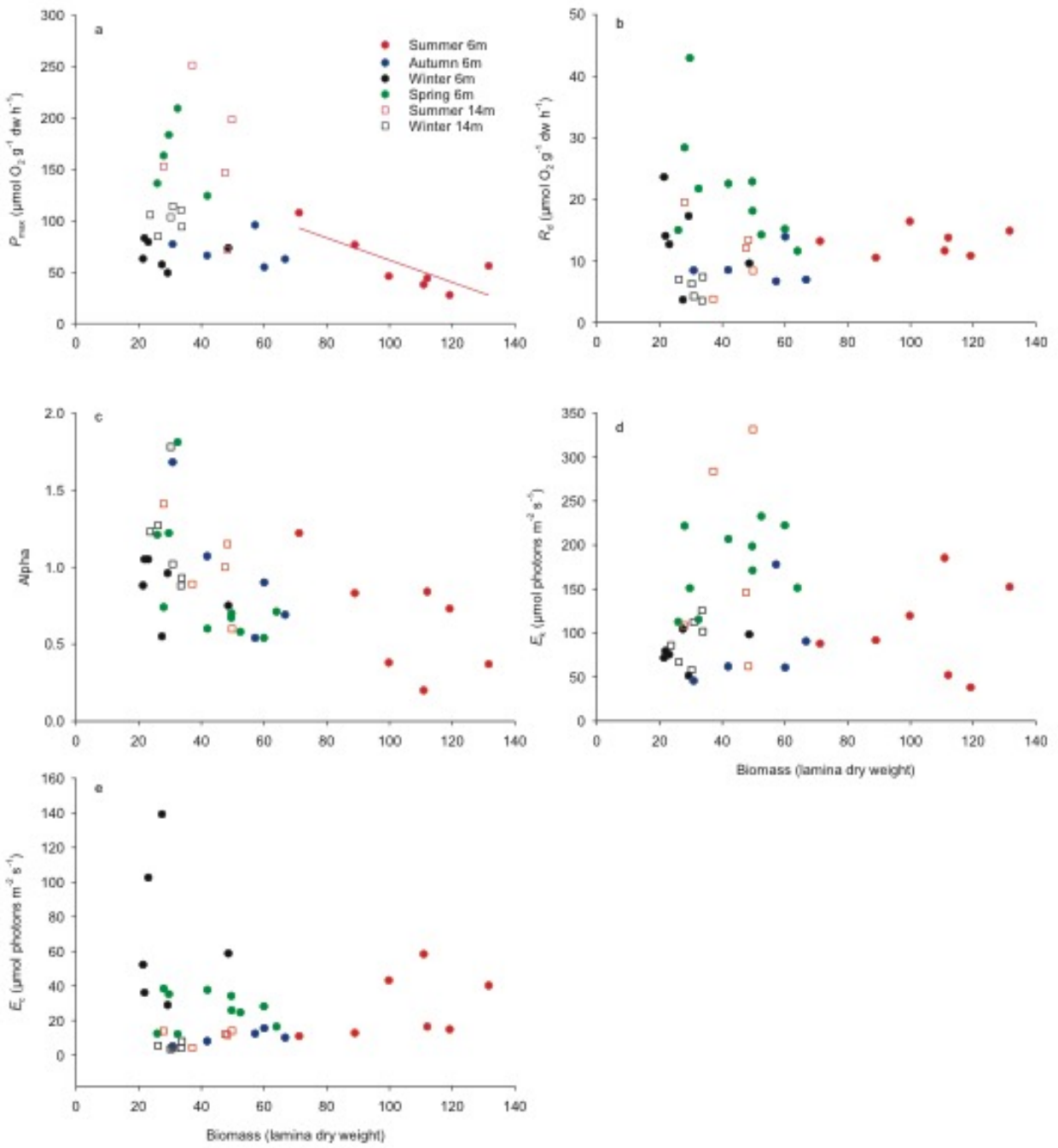

Figure S2. *Ecklonia radiata***.** Seasonal relationship between photosynthetic parameters and biomass (lamina dry weight, g) of kelp at 6 and 14 m depth. (a) maximum photosynthetic rate P_{max}, (b) respiration rate R_d, (c) photosynthetic efficiency alpha (α), (d) saturation irradiance E_k, and (e) compensation irradiance E_c. Significant relationship (r^2 = 0.63, p = 0.03) between biomass and P_{max} for kelp at 6 m depth in Summer is shown (a).

Table S1. Parameter data used for *E. radiata* productivity modelling. Data was obtained from *in situ* photosynthetic measurements, and dry weight (DW) was quantified in the laboratory, except for Autumn and Spring at 14 m depth which were estimated for modelling purposes (shown in italics). Measured on *in situ* kelp: mean (SE) dry weight (DW) of lamina (g), photosynthetic parameters and respiration rates, at 6 m depth in summer 2013, autumn 2012, winter 2013, spring 2013, and at 14 m depth in summer 2013 and winter 2013. P_{max}: maximum rate of photosynthesis (expressed in terms of net primary production (NPP) µmol O_2 g^{-1} dw h^{-1}); α: photosynthetic efficiency, initial slope of the curve at sub-saturating irradiances; E_k: saturation irradiance (µmol photons m^{-2} s^{-1}); E_c: compensation irradiance (µmol photons m^{-2} s^{-1}); R_d: respiration rate (µmol O_2 g^{-1} dw h^{-1}); r^2: fit of *P-E* curve.

Depth (m)	Season/Year	dw	r^2	P_{max}	α	R_d	E_k	E_c
6	Summer 2013	104.8	0.95	56.6	0.65	-13.0	104.0	28.1
	n = 7	(7.6)	(0.01)	(10.3)	(0.13)	(0.8)	(19.9)	(7.1)
	Autumn 2012	51.3	0.99	71.4	0.98	8.9	87.5	10.2
	n = 5	(6.5)	(0.01)	(7.1)	(0.20)	(1.3)	(23.8)	(1.8)
	Winter 2013	28.6	0.98	67.6	0.87	-13.0	80.3	15.0
	n = 6	(4.2)	(0.01)	(5.4)	(0.08)	(2.8)	(7.8)	(2.8)
	Spring 2013	43.3	0.98	143.2	0.88	-21.3	178.4	26.5
	n = 10	(4.4)	(0.01)	(10.2)	(0.13)	(2.9)	(14.0)	(3.2)
14	Summer 2013	42.1	0.98	164.4	1.01	-11.5	186.6	11.2
	n = 5	(4.2)	(0.01)	(29.8)	(0.13)	(2.6)	(19.9)	(1.8)
	Winter 2013	29.7	0.98	102.2	1.19	-5.7	91.9	5.1
	n = 6	(1.6)	(0.01)	(4.5)	(0.14)	(2.8)	(10.7)	(0.8)
	Autumn &	*35.3*		*130.5*	*1.12*	*-8.6*		
	Spring 2013	*(2.8)*		*(16.2)*	*(0.1)*	*(1.6)*		

Text S1. Chlorophyll analysis

Tissue samples were collected from all kelp that were incubated for photosynthetic measurements. The tissue pieces were collected from secondary laminae from the basal third of the primary lamina and stored frozen until pigment analysis was conducted. Chlorophyll (chl) *a* and *c* were extracted using dimethyl sulphoxide (DMSO) and methanol (1:4 v/v) following methods detailed by Duncan and Harrison (1982). The absorbance of chl *a* and *c* were determined spectrophotomically and concentrations of pigments calculated according to the equations of Jeffrey and Haxo (1968).

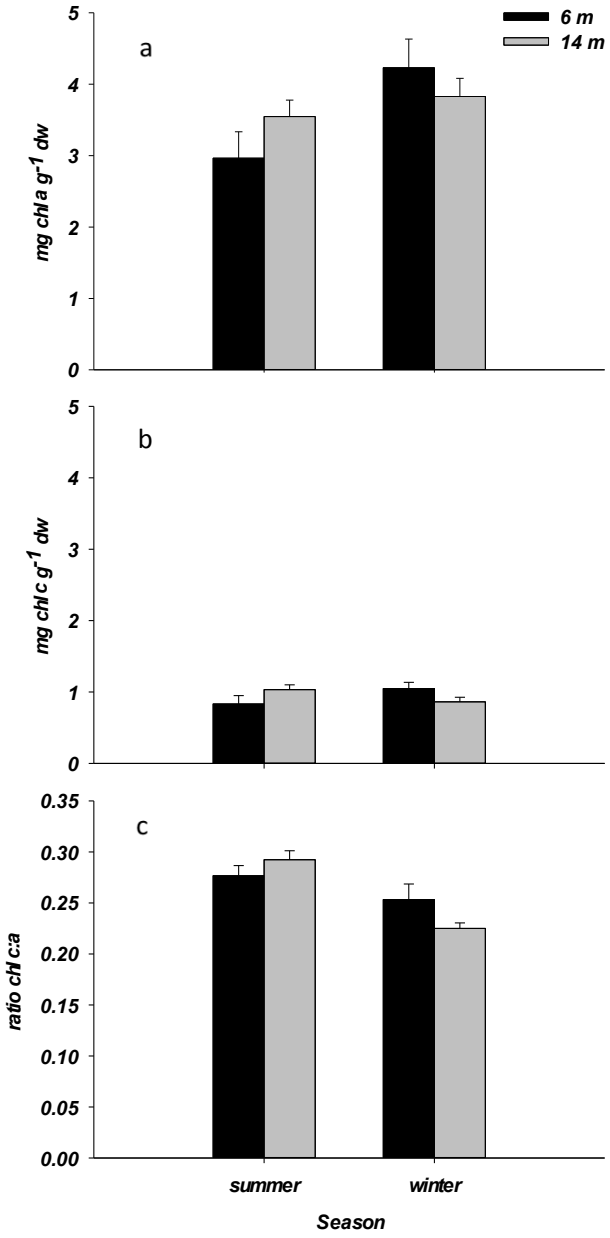

Figure S3. Mean ± SE chlorophyll *a* (a), chlorophyll *c* (b), and chlorophyll *c:a* ratios (c) in *E. radiata* from 6 m depth in summer 2013 (n = 7) and winter 2013 (n = 6) and 14 m depth in summer 2013 (n = 5) and winter 2013 (n = 6).

LITERATURE CITED

Duncan MJ, Harrison PJ (1982) Comparison of solvents for extracting chlorophylls from marine macrophytes. Bot Mar 25:445–447

Jeffrey SW, Haxo FT (1968) Photosynthetic pigments of symbiotic dinoflagellates (zooxanthellae) from corals and clams. Biol Bull 135:149–165