

The following supplement accompanies the article

## Kelp in hot water: I. Warming seawater temperature induces weakening and loss of kelp tissue

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### Supplement.

Table S1. Results of 2-way ANOVA comparing breaking stress, maximum strain, length change and growth rate of *Agarum clathratum*, *Laminaria digitata* and *Saccharina latissima* among 3 exposure times (1-, 2- and 3-week exposure, fixed factor) and 4 tanks (random factor) with all tanks held at 11.5° C. Significant results given in **bold**.

Species	Variable		DF	F	p
<i>A. clathratum</i>	Stress	Tank	3, 24	0.11	0.95
		Exposure	2, 6	10.31	<b>0.01</b>
		Tank x Exp	6, 24	0.58	0.75
	Strain	Tank	3, 23	0.35	0.79
		Exposure	2, 6	6.10	<b>0.04</b>
		Tank x Exp	6, 23	1.45	0.24
	Length change	Tank	3, 24	0.22	0.88
		Exposure	2, 6	23.14	<b>0.002</b>
		Tank x Exp	6, 24	0.17	0.98
	Growth rate	Tank	3, 24	0.38	0.77
		Exposure	2, 6	1.02	0.42
		Tank x Exp	6, 24	1.76	0.15
<i>L. digitata</i>	Stress	Tank	3, 24	1.92	0.15
		Exposure	2, 6	0.67	0.55
		Tank x Exp	6, 24	1.03	0.43
	Strain	Tank	3, 22	1.11	0.36
		Exposure	2, 6	2.48	0.16
		Tank x Exp	6, 22	0.12	0.99
	Length change	Tank	3, 24	0.95	0.43
		Exposure	2, 6	0.31	0.74
		Tank x Exp	6, 24	0.84	0.55
	Growth rate	Tank	3, 24	3.35	<b>0.04</b>
		Exposure	2, 6	0.54	0.61
		Tank x Exp	6, 24	4.71	<b>0.003*</b>
<i>S. latissima</i>	Stress	Tank	3, 24	1.03	0.40
		Exposure	2, 6	3.63	0.09
		Tank x Exp	6, 24	1.53	0.21
	Strain	Tank	3, 24	1.13	0.36
		Exposure	2, 6	1.13	0.38
		Tank x Exp	6, 24	1.72	0.16
	Length change	Tank	3, 24	0.79	0.51

Species	Variable	DF	F	p
	Exposure	2, 6	1.20	0.36
	Tank x Exp	6, 24	1.48	0.23
	Growth rate	Tank	3, 24	2.42
	Exposure	2, 6	10.01	<b>0.01</b>
	Tank x Exp	6, 24	0.40	0.87

\*Effects of tank within each exposure time:

Week1  $F_{3,8}=0.16$ ,  $p=0.92$ ; Week 2  $F_{3,8}=19.46$ ,  $p<0.001$ ; Week 3  $F_{3,8}=1.22$ ,  $p=0.36$

Table S2. Mean ( $\pm$  SE) growth rate ( $\text{mm d}^{-1}$ ) and erosion rate ( $\text{cm wk}^{-1}$ ) of *Saccharina latissima* and *Laminaria digitata* from 4 – 6 m depth at 3 – 5 sites (N) near Halifax, Nova Scotia in summer 2008 and 2009 (based on measurements of 10 – 30 individuals at each site; Krumhansl and Scheibling 2011a). For site locations and measurement methods, see Krumhansl and Scheibling 2011b.

Variable	Species	Date	Mean	SE	N
Growth rate ( $\text{mm d}^{-1}$ )	<i>Saccharina latissima</i>	Jul 2008	5.44	0.85	5
		Sep 2008	4.42	0.47	5
		May 2009	9.09	0.69	5
		Sep 2009	3.06	0.03	5
	<i>Laminaria digitata</i>	Jul 2008	1.99	0.40	3
		Sep 2008	1.48	0.24	4
		May 2009	3.66	0.52	4
		Sep 2009	1.53	0.42	4
Erosion ( $\text{cm wk}^{-1}$ )	<i>Saccharina latissima</i>	Jul 2008	5.22	0.84	5
		Sep 2008	5.38	0.98	5
		May 2009	6.21	1.34	5
		Sep 2009	9.39	1.88	5
	<i>Laminaria digitata</i>	Jul 2008	3.31	1.18	3
		Sep 2008	3.14	0.92	4
		May 2009	4.06	1.13	4
		Sep 2009	4.70	0.64	4

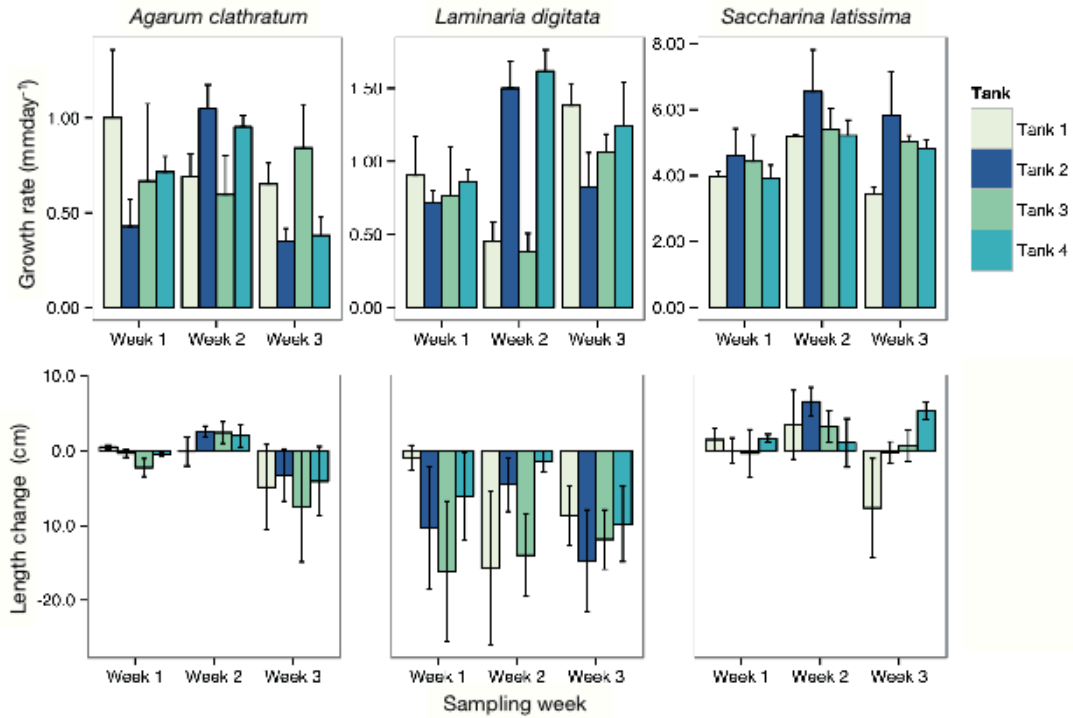


Fig. S1. Mean ( $\pm 1$  SE,  $n=3$ ) growth rate or net length change of *A. clathratum*, *L. digitata*, and *S. latissima* individuals after 1-, 2- or 3-wk exposure at 11.5° C in 4 tanks.

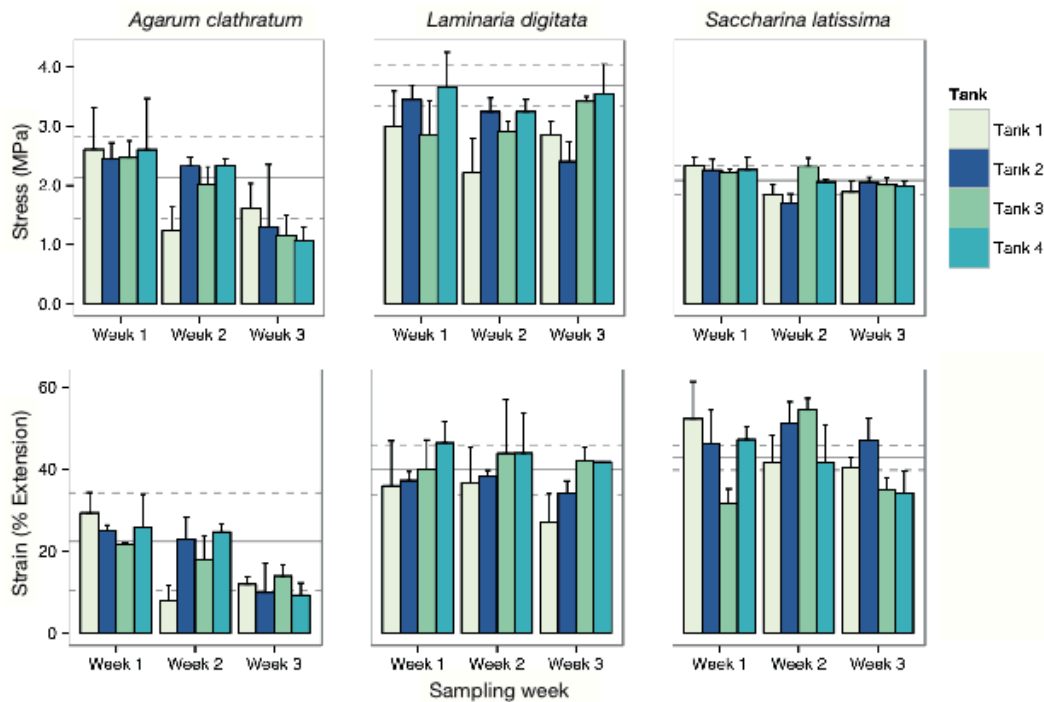


Fig. S2. Mean ( $\pm 1$  SE,  $n=3$ ) stress or strain at breaking of *A. clathratum*, *L. digitata*, and *S. latissima* tissue samples taken after 1-, 2- or 3-wk exposure at 11.5° C in 4 tanks. Solid and dashed lines represent mean  $\pm 1$  SE stress or strain at breaking of initial tissue samples taken upon collection ( $n=3$ ).

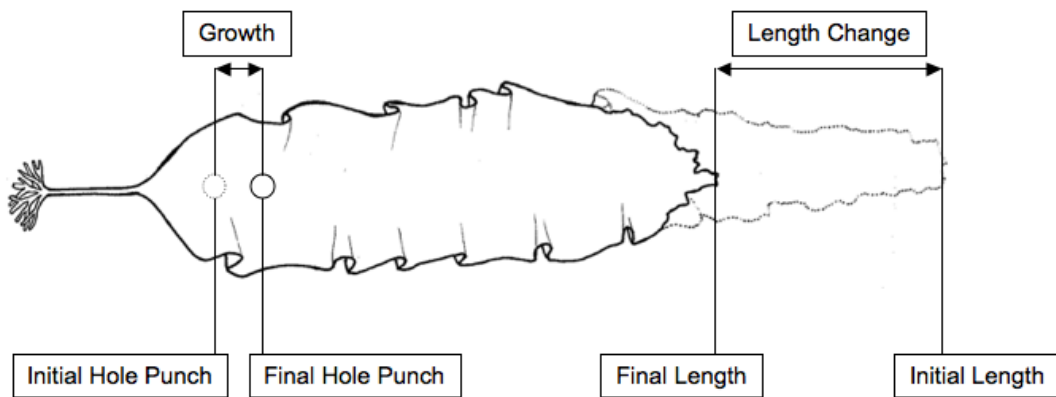


Fig. S3. Schematic showing an individual of *Saccharina latissima* initially (dotted line) and after the set sampling interval (1-, 2-, or 3-wk exposure; solid line), with the measuring protocol for growth (positive) and length change (negative).

#### Literature Cited

- Krumhansl KA, Scheibling RE (2011a) Data from: Detrital production in Nova Scotian kelp beds: patterns and processes. Dryad Digital Repository, <http://dx.doi.org/10.5061/dryad.s3031>
- Krumhansl KA, Scheibling RE (2011b) Detrital production in Nova Scotian kelp beds: patterns and processes. *Mar Ecol Prog Ser* 421:67-82