

Supplement

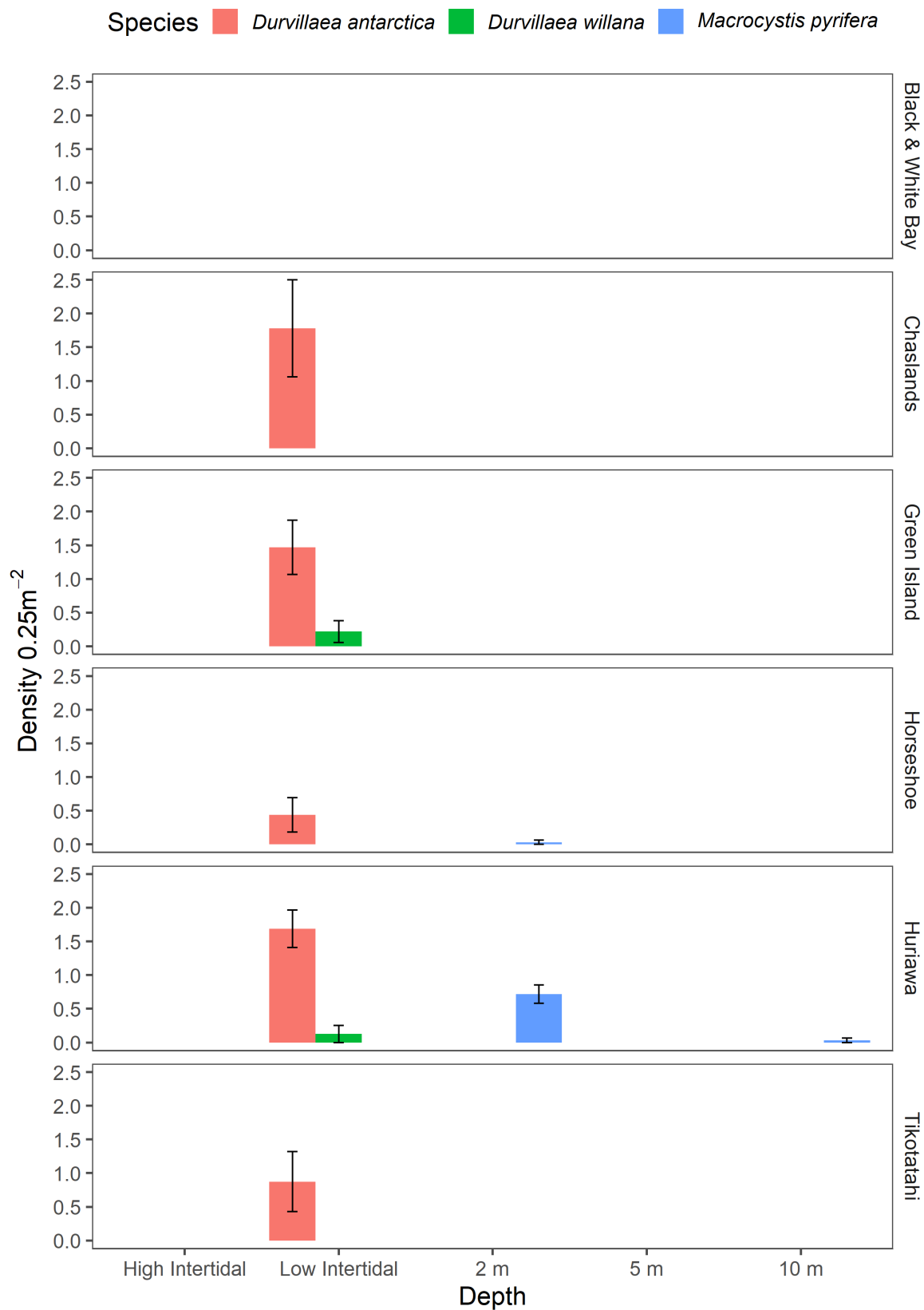


Figure S1: The density of three species of macroalgae obtained from an additional eight 1m² quadrats completed alongside 0.25m² harvested quadrats. The species shown represent those where adult thalli were not harvested for biomass estimates in the 0.25m² quadrats. Note, that juvenile thalli of these species were still harvested. None of the 3 species were found in the additional surveys at Black and White Bay.

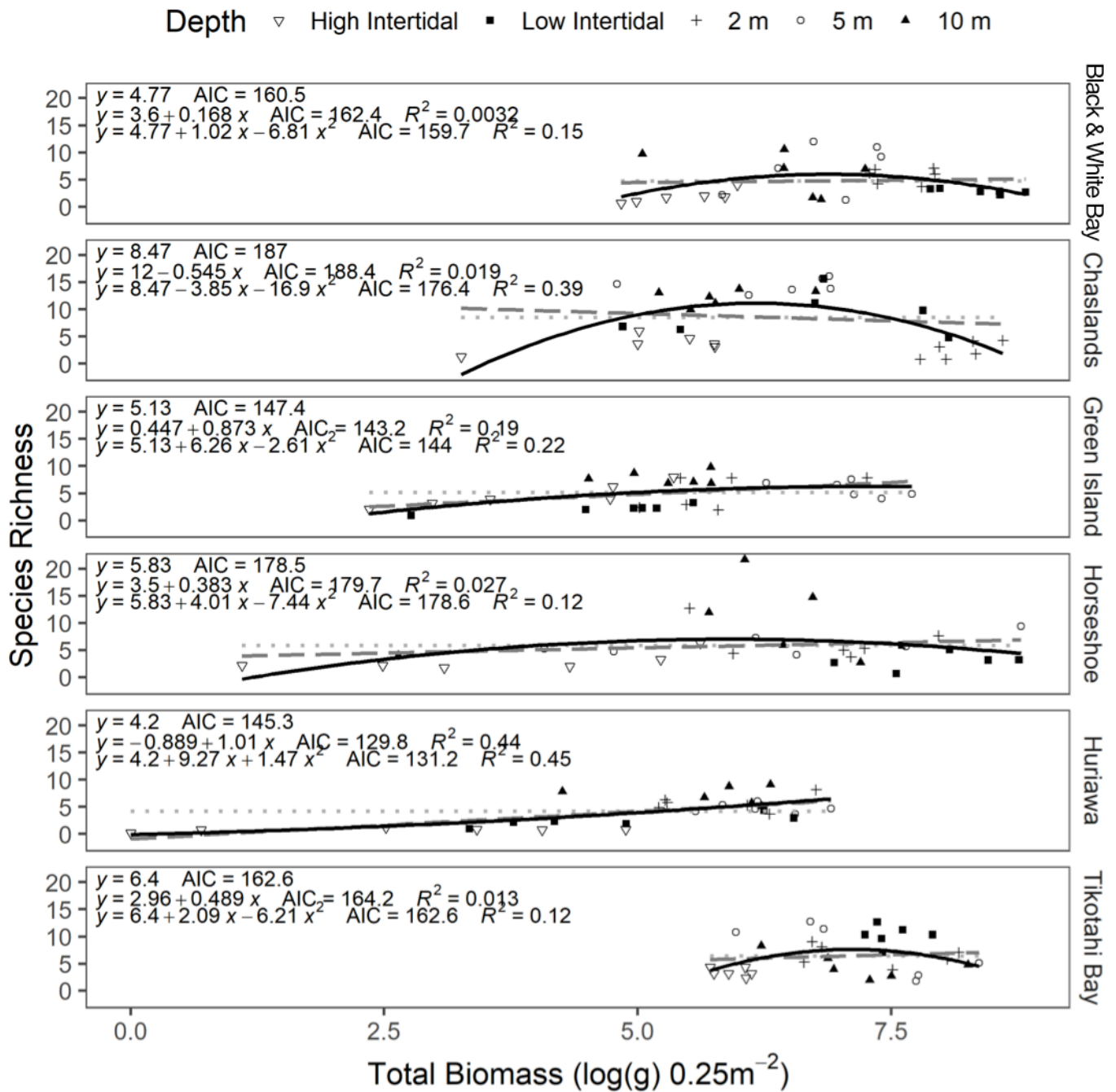


Figure S2: The relationship between species richness (number of species) and total biomass shown on a log scale from the high intertidal down to ten metres depth across six rocky reef systems in southern New Zealand. The dotted light grey line is the null model (richness = intercept), the dashed grey line the linear model (richness = intercept + biomass) and the solid black line is the quadratic model (richness = intercept + biomass + biomass²).

Table S1: Species of algae identified from biomass survey on southern New Zealand rocky reefs. Red = phylum Rhodophyta, green = phylum Chlorophyta and brown = phylum Ochrophyta

Species	Taxonomic grouping	Species	Taxonomic grouping
Brown crust	Brown	<i>Craspedocarpus erosus</i>	Red
<i>Carpomitra costata</i>	Brown	<i>Crassiphycus proliferus</i>	Red
<i>Carpophyllum flexuosum</i>	Brown	<i>Crassiphycus secundatus</i>	Red
<i>Colpomenia</i> sp.	Brown	<i>Dasyclonium</i> spp.	Red
<i>Cystophora platylobium</i>	Brown	<i>Delisea elegans</i>	Red
<i>Cystophora retroflexa</i>	Brown	<i>Delisea plumosa</i>	Red
<i>Cystophora scalaris</i>	Brown	<i>Echinothamnion hystrix</i>	Red
<i>Desmarestia ligulata</i>	Brown	<i>Euptilota formosissima</i>	Red
<i>Dictyota kunthii</i>	Brown	<i>Fulgeophyllis cerasina</i>	Red
<i>Durvillaea antarctica</i>	Brown	<i>Fulgeophyllis laingii</i>	Red
<i>Ecklonia radiata</i>	Brown	<i>Galene meridionalis</i>	Red
<i>Halopteris</i> spp.	Brown	' <i>Gigartina</i> ' <i>ancistroclada</i>	Red
<i>Halopteris virgata</i>	Brown	<i>Gigartina clavifera</i>	Red
<i>Landsburgia quercifolia</i>	Brown	<i>Griffithsia antarctica</i>	Red
<i>Lessonia variegata</i>	Brown	<i>Gymnogongrus furcatus</i>	Red
<i>Macrocystis pyrifer</i>	Brown	<i>Haraldiophyllum crispatum</i>	Red
<i>Marginariella boryana</i>	Brown	<i>Heterosiphonia concinna</i>	Red
<i>Marginariella</i> spp. (juvenile)	Brown	<i>Hildenbrandia</i> sp.	Red
<i>Marginariella urvilleana</i>	Brown	<i>Hymenena</i> sp.	Red
<i>Microzonia velutina</i>	Brown	<i>Iridaea</i> sp.	Red
<i>Phyllotricha verruculosa</i>	Brown	<i>Laingia hookeri</i>	Red
<i>Sargassum sinclairii</i>	Brown	<i>Lophurella</i> sp.	Red
<i>Scytothamnus australis</i>	Brown	<i>Nancythalia humilis</i>	Red
<i>Spatoglossum chapmanii</i>	Brown	<i>Nemalion elminthoides</i>	Red
<i>Splachnidium rugosum</i>	Brown	<i>Nothogenia neilliae</i>	Red
<i>Xiphophora gladiata</i>	Brown	<i>Pachymenia dichotoma</i>	Red
<i>Zonaria</i> spp.	Brown	<i>Pachymenia laciniata</i>	Red
<i>Caulerpa brownii</i>	Green	<i>Paraglossum</i> sp.	Red
<i>Chaetomorpha coliformis</i>	Green	<i>Phycodrys</i> spp.	Red
<i>Codium dimorphum</i>	Green	<i>Plocamium</i> spp.	Red
<i>Ulva</i> spp.	Green	<i>Pterosiphonia</i> sp.	Red
<i>Abroteia suborbiculare</i>	Red	<i>Pterothamnion squarrulosum</i>	Red
Articulated Coralline Algae	Red	<i>Ptilonia willana</i>	Red
<i>Acrosorium decumbens</i>	Red	<i>Pyropia cinnamomea</i>	Red
<i>Adamsiella chauvinii</i>	Red	<i>Pyropia</i> spp.	Red
<i>Anotrichium crinitum</i>	Red	<i>Rhodoglossum</i> sp.	Red
<i>Apophlaea lyallii</i>	Red	<i>Rhodophyllis acanthocarpa</i>	Red

<i>Asparagopsis armata</i>	Red	<i>Rhodophyllis membranacea</i>	Red
<i>Ballia callitricha</i>	Red	<i>Rhodymenia</i> sp.	Red
<i>Blastophyllis calliblepharoides</i>	Red	<i>Rhodymenia wilsonis</i>	Red
<i>Bostrychia arbuscula</i>	Red	<i>Sarcodia grandifolia</i>	Red
<i>Bostrychia intricata</i>	Red	<i>Sarcothalia decipiens</i>	Red
<i>Callophyllis ornata</i>	Red	<i>Sarcothalia lanceata</i>	Red
<i>Camontagnea hirsuta</i>	Red	<i>Sarcothalia livida</i>	Red
<i>Capreolia implexa</i>	Red	<i>Schizoseris</i> spp.	Red
<i>Ceramiceae</i> sp.	Red	<i>Spongoclonium pastorale</i>	Red
<i>Ceramium</i> sp.	Red	<i>Stenogramma interruptum</i>	Red
<i>Champia chathamensis</i>	Red	<i>Streblocladia glomerulata</i>	Red
<i>Chondria macrocarpa</i>	Red	<i>Wendya incisa</i>	Red
<i>Cladhymenia oblongifolia</i>	Red	<i>Zuccarelloa ceramoides</i>	Red
<i>Clymene coleana</i>	Red		

Table S2: Summary table comparing macroalgal A/ biomass (linear mixed model) and B/ species richness (generalised linear mixed regression model with negative binomial family link) across five depth ranges (fixed factor) in southern New Zealand. Site is included as a random factor in both models. High = high intertidal, low = low intertidal, two= two metres below MLW, five = five metres below MLW, and ten= ten metres below MLW. Estimate= parameter estimate, SE= standard error, and p-values <0.05 are in bold.

	Variable	Estimate	SE	t-value	p-value
A/ Biomass					
	Intercept	6.96	0.98	7.14	<0.001
	Low	5.83	0.67	8.70	<0.001
	Two	6.31	0.67	9.41	<0.001
	Five	5.45	0.67	8.12	<0.001
	Ten	3.68	0.67	5.49	<0.001
B/ Species Richness					
	Intercept	1.03	0.14	7.22	<0.001
	Low	0.54	0.15	3.64	<0.001
	Two	0.65	0.15	4.46	<0.001
	Five	0.97	0.14	6.94	<0.001
	Ten	1.05	0.14	7.54	<0.001

Table S3: Results of post-hoc multiple comparisons of A/ Biomass and B/ Species richness for macroalgae across the five depth ranges in southern New Zealand (see Table S2 for model outputs). High = high intertidal, low = low intertidal, two= two metres below MLW, five = five metres below MLW, and ten= ten metres below MLW. Estimate= parameter estimate, SE= standard error, and p-values <0.05 are in bold.

	Comparisons	Estimate	SE	z-value	p-value
A/ Biomass					
	low-high	0.54	0.15	3.64	0.002
	two-high	0.654	0.15	4.45	<0.001
	five-high	0.974	0.14	6.94	<0.001
	ten-high	1.054	0.14	7.54	<0.001
	two-low	0.114	0.13	0.87	0.906
	five-low	0.44	0.12	3.51	0.004
	ten-low	0.52	0.12	4.16	<0.001
	five-two	0.32	0.12	2.62	0.065
	ten-two	0.40	0.12	3.28	0.008
	ten-five	0.08	0.12	0.68	0.960
B/ Species Richness					
	low-high	5.83	0.67	8.60	<0.001
	two-high	6.31	0.67	9.41	<0.001
	five-high	5.45	0.67	8.13	<0.001
	ten-high	3.68	0.67	5.49	<0.001
	two-low	0.48	0.67	0.72	0.953
	five-low	-0.38	0.67	-0.57	0.980
	ten-low	-2.15	0.67	-3.21	0.012
	five-two	-0.86	0.67	-1.28	0.703
	ten-two	-2.63	0.67	-3.93	<0.001
	ten-five	-1.77	0.67	-2.65	0.063

Table S4: Permutational multivariate analysis of variance (PERMANOVA) comparing macroalgal species composition across the five depth ranges (fixed factor) in southern New Zealand. Site is included as a random factor. High = high intertidal, low = low intertidal, two= two metres below MLW, five = five metres below MLW, and ten= ten metres below MLW. For post-hoc tests p-values were adjusted for multiple comparisons. p-values<0.05 are in bold.

	Variable / Comparisons	Mean Squares	F-Model	p-value / Adjusted p-value
Full Model	Depth	1.09	4.55	<0.001
	Residuals	0.23		
Post-hoc test	high-low	1.74	8.69	0.02
	high-two	1.75	7.59	0.03
	high-five	1.6	6.45	0.01
	high-ten	1.59	6.05	0.03
	low-two	0.64	3.89	0.01
	low-five	0.99	4.98	0.01
	low-ten	1.38	7.07	0.01
	two-five	0.32	2.72	0.03
	two-ten	0.72	3.98	0.01
	five-ten	0.13	1.07	1

Table S5: Significant indicator species analysis for algae species from different depth strata across rocky reefs in southern New Zealand. *IndVal* are indicator values, proportion of total biomass is the proportion of the total biomass at the given depth explained by the species. These indicator values range from zero to one, with zero being no preference (or avoidance) for the species towards a particular depth stratum. A value of one represents the species occurring at all sites within a particular depth stratum and absent from all other depth strata at all remaining sites.

Species	IndVal	p-value	Proportion of total biomass
High Intertidal			
<i>Bostrychia arbuscula</i>	1	0.001	0.31
<i>Apophlaea lyallii</i>	0.816	0.001	0.41
Low Intertidal			
<i>Codium dimorphum</i>	0.881	0.001	0.04
<i>Xiphophora gladiata</i>	0.859	0.003	0.76
Articulated coralline algae	0.761	0.005	0.03
<i>Durvillaea antarctica</i> (juveniles)	0.707	0.018	0.08
Two metres			
<i>Marginariella boryana</i>	0.841	0.017	0.4
<i>Dictyota kunthii</i>	0.698	0.025	<0.01
Five + Ten metres			
<i>Craspedocarpus erosus</i>	0.859	0.002	<0.01
<i>Plocamium</i> spp.	0.85	0.004	0.01
<i>Caulerpa brownii</i>	0.814	0.01	0.14
<i>Carpomitra costata</i>	0.764	0.007	<0.01
<i>Ecklonia radiata</i>	0.764	0.012	0.14
<i>Euptilota formosissima</i>	0.758	0.01	<0.01
<i>Cladhymenia oblongifolia</i>	0.707	0.019	<0.01
<i>Adamsiella chauvinii</i>	0.645	0.05	<0.01
<i>Rhodophyllis membranacea</i>	0.645	0.037	<0.01

Table S6: The percentage cover of sessile invertebrates (all species combined) and the density of large mobile grazing invertebrates at each of the five depth strata identified from an additional eight 1m² quadrats completed alongside 0.25m² harvested quadrats.

Depth	Sessile (%)	Mobile (0.25m ⁻²)		
	Invertebrates ± SE	<i>Evechinus chloroticus</i> ± SE	<i>Haliotis</i> spp. ± SE	<i>Scutus breviculus</i> ± SE
High	2.3 ± 0.5	0.005 ± 0.005	0	0
Low	0.2 ± 0.1	0	0	0
Two	9.6 ± 2.5	0.01 ± 0.007	0.005 ± 0.005	0
Five	17.8 ± 3.8	0.011 ± 0.007	0	0
Ten	14.0 ± 2.4	0.005 ± 0.005	0.01 ± 0.01	0.01 ± 0.007