

SUPPLEMENTARY INFORMATION

Identifying niche and fitness dissimilarities in invaded marine macroalgal canopies within the context of contemporary coexistence theory.

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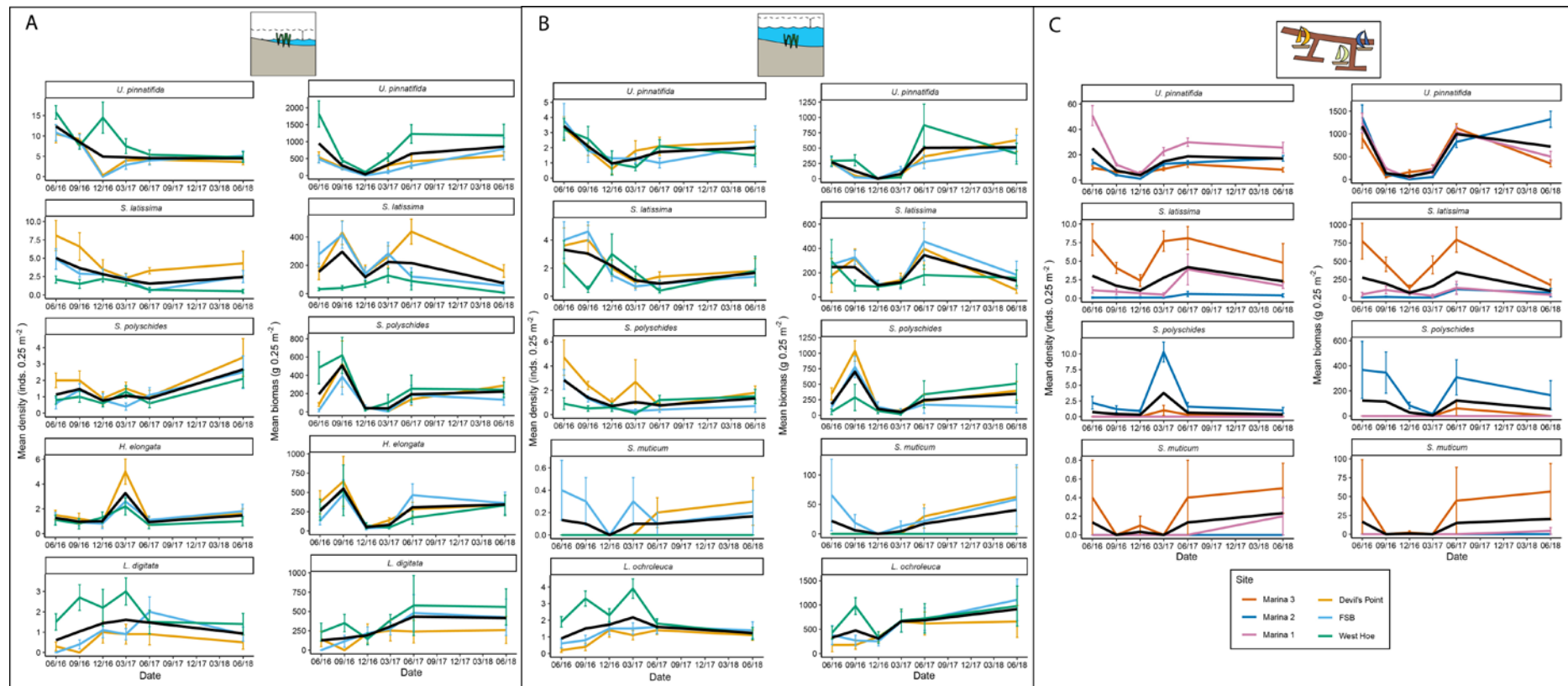


Fig S1 Mean density (L) and biomass (R) of canopy-forming macroalgae per 0.25 m² (± standard error) for each site at every sampling event. Data are separated by habitat – intertidal reef (A), subtidal reef (B) and marinas (C). Black lines indicate average across sites.

Table S1 Results from PERMANOVA models testing for difference in composition of canopy-forming macroalgae between years. Each habitat was analysed separately, and models were constructed both on count and biomass data. Site was also included as a random factor in all models. The degrees of freedom (df), pseudo F-value (F) and p-value (*p*) are shown for each coefficient. Significant coefficients shown in bold ($\alpha=0.05$).

Coefficient	Intertidal reef			Subtidal reef		Marina	
	df	F	p	F	p	F	p
<i>Biomass</i>							
Year	2	2.27	0.052	0.72	0.574	1.17	0.335
Site	2	3.75	0.003	1.79	0.134	20.00	<0.001
<i>Density</i>							
Year	2	5.13	<0.001	2.02	0.111	1.45	0.205
Site	2	5.15	<0.001	2.29	0.074	27.03	<0.001

Table S2 Post-hoc pairwise PERMANOVA on the composition of canopy-forming macroalgae (by density) in the intertidal habitat, testing for the effect of year. t value (*t*) and p-value (*p*) are shown for each pairwise comparison. Significant coefficients shown in bold ($\alpha=0.05$).

Years	t	p
2016, 2017	2.26	0.006
2016, 2018	3.09	<0.001
2017, 2018	1.46	0.136

Table S3 SIMPER analysis on composition of canopy-forming macroalgae, selecting only significant pairwise contrasts indicated from post-hoc pairwise PERMANOVA (Table S2). Average proportion of each species (square root transformed) are shown, with their percentage contribution to the dissimilarity when compared to 2016 (Contrib %).

Species	2016	2017		2018	
	Av. Prop	Av. Prop	Contrib (%)	Av. Prop	Contrib (%)
<i>S. latissima</i>	4.21	2.90	22.64	2.97	21.98
<i>L. digitata</i>	0.96	2.95	22.38	2.22	17.47
<i>U. pinnatifida</i>	7.58	5.97	20.5	5.53	20.67
<i>H. elongata</i>	1.95	2.49	17.96	3.07	19.08
<i>S. polyschides</i>	1.90	2.06	16.51	3.84	20.81

Table S4 Results from ANOVA models on density or percent cover of canopy-forming macroalgae, testing for the effects of substrate (New or Old) and Date (sampling month) on marina pontoons. F-values (F) and p-values (p) shown for each coefficient and species separately. Significant coefficients shown in bold ($\alpha=0.01$).

Coefficient	df	<i>U. pinnatifida</i>		<i>S. latissima</i>		<i>L. digitata</i>	
		F	p	F	p	F	p
<i>Density</i>							
Date	14	103.1	<0.001	11.2	<0.001	2.5	0.004
Substrate	1	221.0	<0.001	20.1	<0.001	151.6	<0.001
Date*Substrate	14	39.7	<0.001	7.5	<0.001	2.3	0.007
<i>Canopy-cover</i>							
Date	14	86.9	<0.001	6.4	<0.001	3.1	<0.001
Substrate	1	217.9	<0.001	0.7	0.408	142.4	<0.001
Date* Substrate	14	22.4	<0.001	4.5	<0.001	3.0	<0.001

Table S5 Pairwise tests for density or percent cover of canopy-forming macroalgae, testing for differences between new and old marina substrates at each sampling event. F-values (F) shown with Holm adjusted p-values (p) for each pairwise contrast. Significant coefficients shown in bold ($\alpha=0.01$).

Date	<i>U. pinnatifida</i>		<i>S. latissima</i>		<i>L. digitata</i>	
	F	p	F	p	F	p
<i>Density</i>						
03/2016	118.05	<0.001	7.51	0.071	<0.01	1.000
06/2016	393.13	<0.001	12.69	0.006	<0.01	1.000
10/2016	170.57	<0.001	2.29	0.931	17.58	0.001
12/2016	79.16	<0.001	0.05	1.000	17.64	0.001
03/2017	2.84	0.948	0.07	1.000	19.57	<0.001
04/2017	0.13	1.000	1.31	1.000	20.60	<0.001
05/2017	0.61	1.000	19.05	<0.001	21.02	<0.001
06/2017	0.17	1.000	35.64	<0.001	18.94	<0.001
07/2017	1.17	1.000	20.70	<0.001	12.42	0.004
08/2017	0.15	1.000	7.19	0.075	16.68	0.001
09/2017	1.91	1.000	15.73	0.001	13.82	0.002
10/2017	1.36	1.000	2.89	0.734	8.22	0.029
11/2017	3.68	0.631	0.25	1.000	5.52	0.082
12/2017	2.67	0.948	0.06	1.000	8.22	0.029
01/2018	1.12	1.000	<0.01	1.000	3.91	0.151
<i>Canopy-cover</i>						
03/2016	10.08	0.020	8.79	0.048	<0.01	1.000
06/2016	313.68	<0.001	8.53	0.050	<0.01	1.000
10/2016	123.89	<0.001	6.95	0.105	7.85	0.037
12/2016	28.94	<0.001	1.89	1.000	13.06	0.004
03/2017	5.60	0.157	0.52	1.000	25.82	<0.001
04/2017	16.23	0.001	<0.01	1.000	31.16	<0.001
05/2017	3.27	0.439	0.97	1.000	18.77	<0.001
06/2017	8.09	0.047	10.67	0.020	21.06	<0.001
07/2017	10.22	0.020	5.03	0.241	13.47	0.003
08/2017	2.49	0.468	6.74	0.106	19.82	<0.001
09/2017	3.23	0.439	13.26	0.006	15.17	0.002
10/2017	4.46	0.257	0.34	1.000	8.09	0.037
11/2017	1.00	0.955	0.13	1.000	3.02	0.338
12/2017	0.88	0.955	0.01	1.000	3.87	0.257
01/2018	<0.01	0.984	0.06	1.000	2.69	0.338

Table S6 Results from ANOVA models on density or percent cover of canopy-forming macroalgae, testing for the effects of substrate (New or Old) and Date (sampling month) on intertidal reef. F-values (F) and p-values (p) shown for each coefficient and species separately. Significant coefficients shown in bold ($\alpha=0.01$).

		<i>U. pinnatifida</i>		<i>S. latissima</i>		<i>L. digitata</i>		<i>S. polyschides</i>		<i>H. elongata</i>	
Coefficient	df	F	p	F	p	F	p	F	p	F	p
<i>Density</i>											
Date	10	39.2	<0.001	2.3	0.022	2.4	0.018	13.3	<0.001		
Substrate	1	65.6	<0.001	4.4	0.039	453.7	<0.001	24.5	<0.001		
Date *Substrate	10	22.2	<0.001	1.0	0.441	7.6	<0.001	13.6	<0.001		
<i>Canopy-cover</i>											
Date	10	19.9	<0.001	1.8	0.069	5.4	<0.001	11.0	<0.001	17.4	<0.001
Substrate	1	28.3	<0.001	2.3	0.137	309.1	<0.001	29.0	<0.001	109.9	<0.001
Date* Substrate	10	6.2	<0.001	0.6	0.788	4.0	<0.001	11.0	<0.001	4.4	<0.001

Table S7 Pairwise tests for density or percent cover of canopy-forming macroalgae, testing for differences between new and old intertidal substrates at each sampling event. F-values (F) shown with Holm adjusted p-values (p) for each pairwise contrast. Significant coefficients shown in bold ($\alpha=0.01$).

Date	<i>U. pinnatifida</i>		<i>S. latissima</i>		<i>L. digitata</i>		<i>S. polyschides</i>		<i>H. elongata</i>	
	F	p	F	p	F	p	F	p	F	p
<i>Density</i>										
03/2017	0.99	1.00	3.15	0.805	46.96	<0.001	<0.01	1.000		
05/2017	191.34	<0.001	0.85	1.000	40.65	<0.001	147.93	<0.001		
06/2017	46.19	<0.001	0.90	1.000	143.82	<0.001	11.79	0.010		
08/2017	49.07	<0.001	2.61	0.998	84.53	<0.001	0.67	1.000		
10/2017	0.25	1.000	5.59	0.231	62.89	<0.001	<0.01	1.000		
12/2017	0.00	1.000	0.18	1.000	63.37	<0.001	<0.01	1.000		
02/2018	0.15	1.000	0.23	1.000	27.89	<0.001	<0.01	1.000		
03/2018	<0.01	1.000	0.23	1.000	20.00	<0.001	<0.01	1.000		
04/2018	0.01	1.000	0.23	1.000	22.29	<0.001	<0.01	1.000		
06/2018	<0.01	1.000	0.47	1.000	11.88	0.002	<0.01	1.000		
07/2018	<0.01	1.000	0.12	1.000	5.86	0.018	<0.01	1.000		
<i>Canopy-cover</i>										
03/2017	0.51	1.000	2.00	1.000	67.03	<0.001	0.00	1.000	16.94	0.001
05/2017	39.54	<0.001	0.01	1.000	52.64	<0.001	147.93	<0.001	36.35	<0.001
06/2017	33.26	<0.001	0.58	1.000	44.73	<0.001	11.79	0.010	54.85	<0.001
08/2017	15.71	0.002	1.23	1.000	39.05	<0.001	0.67	1.000	16.86	0.001
10/2017	0.44	1.000	3.19	0.868	42.04	<0.001	<0.01	1.000	9.86	0.018
12/2017	0.27	1.000	0.30	1.000	19.27	<0.001	<0.01	1.000	0.94	0.576
02/2018	0.24	1.000	0.23	1.000	18.45	<0.001	<0.01	1.000	2.19	0.575
03/2018	<0.01	1.000	0.25	1.000	35.42	<0.001	<0.01	1.000	1.71	0.576
04/2018	0.44	1.000	0.05	1.000	21.49	<0.001	<0.01	1.000	1.74	0.576
06/2018	<0.01	1.000	0.11	1.000	4.91	0.0603	<0.01	1.000	7.94	0.038
07/2018	<0.01	1.000	0.55	1.000	3.83	0.0603	<0.01	1.000	4.30	0.211

