Online supplement.

Table S1. Effects of removal of intermediate habitat former on estuarine focal organisms; site specific mean values with standard deviations (SD). The experiment was conducted at North Bay Creek (37°27'9.22"N, 75°40'29.29"W), South Bay Creek (37°17'22.10"N, 75°54'46.50"W), and Oyster Harbor Creek (37°17'20.49"N, 75°55'13.65"W). The experiment compared species richness and abundance of sessile and mobile invertebrates (focal taxa) in sedimentary plots without any biogenic habitat formers (S), plots with presence of both basal and intermediate habitat formers (B(S)+I) and plots where the intermediate habitat former was removed (B(S). Grac. = gWW of individual *Gracilaria* sp. (= intermediate habitat). Richness data = focal taxa per sample core. Abundance of sessile and mobile focal organisms was reported as gWW or counts per sample core, respectively. We started out with 12 replicates per site (N), but some plots were lost due to boating and feeding activity of birds and rays. Others were discarded if treatments changed by natural means during the experiments. Natural changes occurred because *Gracilaria* was lost during storms from a few control plots (i.e. where biogenic habitat formers were supposed to be present) or if *Gracilaria* re-appeared with large biomass in removal treatments (in a few cases *D. cuprea* re-incorporated large amounts of *Gracilaria* despite repeated removals).

SITE	HABITAT	N	*Grac.*	SD	richness sessile	SD	richness mobile	SD	abundance sessile	SD	abundance mobile	SD
South Bay Creek	S	9	0.018	0.016	0.000	0.000	1.111	1.269	0.000	0.000	1.222	1.394
	B(S)	7	0.719	0.740	0.857	0.690	2.429	1.512	0.017	0.014	4.571	3.910
	B(S)+I	11	6.324	3.024	1.000	0.894	4.000	1.000	0.027	0.026	10.909	6.992
North Hog Beach	S	7	0.000	0.000	0.000	0.000	0.857	0.900	0.000	0.000	1.000	1.155
	B(S)	5	0.544	0.661	1.000	1.414	2.800	1.095	0.392	0.790	10.400	2.702
	B(S)+I	8	3.226	1.629	3.375	2.066	3.500	0.756	0.166	0.178	16.375	4.627
Oyster Harbor Creek	S	7	0.000	0.000	0.000	0.000	0.571	0.535	0.000	0.000	0.571	0.535
	B(S)	12	0.532	0.422	0.333	0.492	2.083	1.240	0.007	0.010	3.167	2.855
	B(S)+I	7	4.319	1.411	1.286	1.254	4.714	0.951	0.026	0.025	9.857	3.237

Table S2. Effects of removal of intermediate habitat former on estuarine focal organisms; ANOVA results testing for differences in species richness and abundance of sessile and mobile invertebrates (focal organisms) between sedimentary plots without any biogenic habitat formers, plots with presence of both basal and intermediate habitat formers and plots where the intermediate habitat former was removed (Habitat, fixed factor). See table S1 for mean values of specific treatments. Significant results are in bold.

	Source	**Hypothesis**	**df**	**MS**	**F**	**P**
Richness	Habitat	Hypothesis	2	7.514	9.325	**0.0261**
Sessile		Error	4.4	0.806		
Taxa	Sites	Hypothesis	2	0.579	0.721	0.5364
		Error	4.4	0.803		
	Habitat×Site	Hypothesis	4	0.785	0.442	0.7775
		Error	64	1.773		
Richness	Habitat	Hypothesis	2	0.697	0.796	0.5039
Mobile		Error	4.7	0.875		
Taxa	Sites	Hypothesis	2	1.539	1.772	0.2690
		Error	4.6	0.869		
	Habitat×Site	Hypothesis	4	0.826	0.266	0.8984
		Error	64	3.100		
Abundance	Habitat	Hypothesis	2	0.150	1.858	0.2666
Sessile		Error	4.1	0.081		
Taxa	Sites	Hypothesis	2	0.086	1.064	0.4249
		Error	4.1	0.081		
	Habitat×Site	Hypothesis	4	0.081	1.932	**0.0959**
		Error	64	0.042		
Abundance	Habitat	Hypothesis	2	151.302	5.873	**0.0494**
Mobile		Error	4.3	25.764		
Taxa	Sites	Hypothesis	2	27.786	1.080	0.4178
		Error	4.2	25.727		
	Habitat×Site	Hypothesis	4	25.478	0.657	0.6242
		Error	64	38.790		

Table S3. Broad scale survey of focal organisms in estuarine habitat cascades; site specific mean values with standard deviations (SD). Individual samples were classified as 'B(I)' (basal habitat former, with small amount of intermediate habitat-former) or 'B+I' (basal habitat former with large amounts of intermediate habitat former). For taxonomic details on basal and intermediate habitat-formers, see Figure S1. CI = Chincoteague Island, HIB = Hog Island Bay, SB = South Bay. Grac. = gWW of individual *Gracilaria* sp. (= intermediate habitat). Richness data = focal taxa per *Gracilaria* individual (including the basal habitat former). Abundance of sessile and mobile focal organisms was reported as gWW or counts per *Gracilaria* individual (including the basal habitat former), respectively.

Region	Site	Treatment	N	Grac.	SD	Richness Sessile	SD	Richness Mobile	SD	Abundance Sessile	SD	Abundance Mobile	SD
WA	Heahthote	B+I	4	1.813	0.456	0.750	0.500	2.000	1.414	0.150	0.100	25.750	6.702
		B(I)	4	1.120	0.141	1.000	0.816	1.750	0.500	0.200	0.163	18.750	3.775
	Attadale	B+I	5	5.022	1.774	1.400	0.548	4.200	1.304	0.400	0.141	15.200	9.445
		B(I)	4	2.230	0.608	1.000	0.816	4.250	1.258	0.450	0.379	8.500	3.000
	Armstrong Spit	B+I	4	1.735	0.687	1.750	0.500	4.250	1.500	0.850	1.038	40.000	28.554
		B(I)	4	1.017	0.023	1.667	0.577	3.000	0.000	0.400	0.200	25.000	9.165
	Waylen Bay	B+I	5	3.876	0.685	2.400	0.548	5.200	1.304	0.560	0.167	46.200	28.217
		B(I)	4	2.500	0.306	1.750	0.957	5.500	1.291	0.350	0.191	38.750	24.500
	Pelican Point	B+I	5	0.818	0.240	2.800	0.837	3.200	0.447	0.600	0.245	25.200	9.039
		B(I)	4	0.443	0.086	1.500	0.577	3.250	0.957	0.300	0.115	8.500	2.646
DK	Holkenhavn Fjord	B+I	6	42.426	33.299	2.500	0.548	4.167	1.169	0.120	0.018	63.500	80.281
		B(I)	5	7.501	3.672	3.000	1.000	2.400	1.517	0.120	0.020	6.800	2.280
	Mandoe	B+I	6	48.500	10.397	4.333	1.033	5.833	1.169	0.667	0.755	211.000	221.624
		B(I)	4	14.900	6.302	2.667	0.577	4.333	2.082	0.270	0.236	23.667	12.503
	Horsens Fjord	B+I	5	43.145	17.011	2.600	0.894	3.000	2.000	0.112	0.041	25.600	10.139
		B(I)	4	9.000	0.611	1.500	1.291	4.000	1.826	0.070	0.060	25.000	23.819
	Snaptun Harbor	B+I	4	82.250	40.593	5.500	1.732	3.000	1.633	6.105	10.629	151.500	126.284
		B(I)	5	19.020	11.615	3.200	2.387	2.000	1.000	0.292	0.420	13.400	13.539
NZ	Browns bay	B+I	9	17.830	6.511	3.800	1.033	3.600	1.350	2.037	2.096	17.910	12.600
		B(I)	8	5.614	2.172	2.429	0.787	1.714	0.756	1.281	1.318	7.143	4.413
	Mana	B+I	9	15.110	4.782	3.700	0.675	5.300	1.494	5.516	3.359	77.600	52.468
		B(I)	8	7.113	1.262	3.250	0.886	4.875	0.835	10.178	15.024	58.500	44.375
	Ration Point	B+I	10	16.250	11.385	1.400	1.350	2.600	1.174	0.262	0.302	17.000	25.020
		B(I)	9	2.956	1.100	0.889	0.928	2.000	1.000	0.231	0.400	4.889	4.540

	Camborne	B+I	9	18.133	6.079	2.778	1.202	1.778	1.302	2.957	3.354	5.444	6.085
		B(I)	9	8.644	2.790	2.889	1.167	2.222	1.302	1.152	0.923	7.889	4.781
VA	CI Bridge Channel	B+I	4	7.750	4.306	7.750	1.708	4.250	1.708	4.233	6.317	33.000	16.833
		B(I)	4	1.625	0.854	3.750	2.062	2.750	2.062	0.650	0.513	18.250	10.404
	CI Toms Cove	B+I	4	9.450	6.751	3.500	1.291	2.750	0.957	3.335	4.615	19.750	13.598
		B(I)	4	2.418	1.335	2.250	0.500	1.750	0.957	0.208	0.173	5.000	2.582
	HIB North Hog	B+I	4	9.505	3.168	4.000	1.414	2.500	0.577	2.890	3.092	34.000	28.484
		B(I)	3	1.413	1.837	3.333	1.528	3.000	1.000	0.473	0.681	22.667	16.803
	HIB Shoal 1	B+I	3	29.833	25.468	2.333	1.528	5.000	1.000	0.227	0.192	1066.667	1084.613
		B(I)	3	5.962	3.579	0.333	0.577	4.667	1.528	0.007	0.012	239.000	95.357
	SB Creek	B+I	5	30.420	10.932	3.400	1.140	5.000	1.581	0.104	0.017	58.800	32.112
		B(I)	5	9.980	1.760	2.600	0.894	3.200	0.837	0.080	0.042	18.200	6.099
	SB Oyster Creek	B+I	5	7.388	1.974	1.600	1.342	1.400	0.548	0.274	0.377	6.000	3.674
		B(I)	5	2.004	1.705	0.200	0.447	1.600	0.548	0.004	0.009	8.600	4.506
	SB Seagrass bed	B+I	4	6.218	2.904	6.000	2.944	5.000	2.000	2.975	2.894	17.750	5.439
		B(I)	5	0.932	0.852	4.000	2.000	5.000	1.414	3.222	3.231	13.000	5.788
	SI Deep Sandflat	B+I	4	12.690	7.810	4.250	0.957	5.500	2.887	8.268	8.467	600.500	665.735
		B(I)	4	1.425	1.057	4.000	1.826	5.250	2.630	6.890	6.953	212.250	307.983
	SI Seagrass bed	B+I	5	39.720	23.177	6.600	3.286	8.000	2.915	7.082	5.548	461.048	428.829
		B(I)	4	7.347	5.830	5.000	1.000	5.667	3.055	2.920	3.388	23.373	17.493
	SI Shallow mudflat	B+I	5	28.430	13.107	3.200	0.837	3.800	1.304	5.312	6.706	18.000	23.098
		B(I)	4	6.053	6.325	3.250	2.217	4.500	3.109	0.345	0.546	12.750	8.655

Table S4. Broad scale survey of focal organisms in estuarine habitat cascades; ANOVA results testing for differences in species richness and abundance of sessile and mobile invertebrates (focal organisms) in treatments of high and low *Gracilaria* density (intermediate Habitat, fixed factor) in different biogeographical regions (Region, random factor) and at different Sites nested within regions [Si(Re), random factor]. All data were Log+1 transformed prior to analysis. Significant results are in bold. See also table S3.

Source	**df**	**MS**	**F**	**P**	**MS**	**F**	**P**
		Richness, sessile			**Richness, mobile**		
Region	3	2.205	0.43	0.269	0.711	0.65	0.573
Habitat	1	3.138	16.4	**0.014**	0.914	17.3	**0.011**
Site(Region)	19	1.44	10. 8	**0.001**	1.037	7.96	**0.001**
RexHa	3	0.196	1.33	0.287	0.045	0.36	0.801
Si(Re)xHa	19	0.144	1.08	0.357	0.145	1.11	0.339
Residual	189	0.134			0.130		
		Abundance, sessile			**Abundance, mobile**		
Region	3	4.782	1.78	0.180	11.49	1.14	0.347
Habitat	1	3.572	9.31	**0.044**	30.83	10.8	**0.026**
Site(Region)	19	2.513	7.16	**0.001**	9.397	12.7	**0.001**
RexHa	3	0.390	1.50	0.239	3.010	2.06	0.136
Si(Re)xHa	19	0.259	0.74	0.791	1.388	1.88	**0.020**
Residual	189	0.351			0.738		

Table S5. Magnification ratios (MR) in habitat cascades. The list is not an exhaustive list of all published data from all habitat cascades. Fig. = Figure; Txt = Text. Soil/Sediments samples without habitat-formers and samples of the Basal and the Intermediate habitats are referred to as Habitat "S", "B" and "I", respectively. The combined habitats with both biogenic habitat formers are referred to as "B+I". Typically, "B", "I" and "B+I" data (i.e. without "S") are obtained when focal organisms are quantified from tree crown traps or by collection of individual seagrass leaves, seaweeds or nets-epiphytes. Quantification of focal organism founded on ground-based areal sampling (e.g. cores and quadrats) typically include organisms also associated with the sediment/soil matrix, and are here referred to as "B(S)", "I(S)", and "B(S)+I". Raw values were extracted from figures, tables and text. Data from the lowest habitat level were standardized to 1 'unit'. Magnification factors were calculated for increasing habitat levels by division with the value reported from the lowest recorded habitat level. In a few cases mean value were 0 at the lowest measured habitat level. In these cases we report the 0-value and use the next lowest recorded habitat level as the new 1-unit reference.

Study	Focal taxa	Response	Data	S	B	B(S)	I	I(S)	B+I	B(S)+I	Comments
Altieri	Algae	Abundance group	Fig 5	1.0		12.9		0.3		8.8	
Et al	Barnacle	Abundance group	Fig 5	1.0		6.0		7.3		29.7	
2007	Blue mussels	Abundance group	Fig 5	1.0		10.6		2.0		50.6	
	Blue mussels recruit	Abundance group	Fig 5	1.0		6.5		2.1		13.6	
	Littorina	Abundance group	Fig 5	1.0		1.3		1.7		2.1	
	Ribbed mussel recruit	Abundance group	Fig 5	1.0		0.6		0.6		1.7	
	Asien crab	Abundance group	Fig 2			1.0		0.3		3.0	
	Natives	Richness	Fig 2	1.0		1.9		1.5		2.0	
Bologna &	Invertebrate	Richness	Fig. 3			1.0				0.9	mimic epiphyte
Heck 1999	Invertebrate	Richness	Fig. 3			1.0				1.4	natural epiphye
	Fauna Herbivore	Abundance all	Fig. 3			1.0				0.9	mimic epiphyte
	Fauna Herbivore	Abundance all	Fig. 3			1.0				2.1	natural epiphye
	Fauna Non-herbivore	Abundance all	Fig. 3			1.0				1.0	mimic epiphyte
	Fauna Non-herbivore	Abundance all	Fig. 3			1.0				2.8	natural epiphye
Cruz-Angon	Birds	Abundance all	Fig 2			1.0				1.6	Breeding season North
& Greenberg	Birds	Abundance all	Fig 2			1.0				1.1	Non-breeding season North
2005	Birds	Abundance all	Fig 2			1.0				1.9	Breeding season South
	Birds	Abundance all	Fig 2			1.0				1.3	Non-breeding season South
	Birds	Richness	Fig. 1			1.0				0.8	Breeding season 100 ind North
	Birds	Richness	Fig. 1			1.0				0.8	Breeding season 200 ind North

	Birds	Richness	Fig. 1		1.0		0.8	Breeding season 50 ind North
	Birds	Richness	Fig. 1		1.0		1.1	Breeding season 100 ind North
	Birds	Richness	Fig. 1		1.0		1.1	Breeding season 200 ind North
	Birds	Richness	Fig. 1		1.0		1.1	Breeding season 50 ind North
	Birds	Richness	Fig. 1		1.0		1.0	Non-breeding season 100 ind South
	Birds	Richness	Fig. 1		1.0		1.0	Non-breeding season 200 ind South
	Birds	Richness	Fig. 1		1.0		0.9	Non-breeding season 50 ind South
	Birds	Richness	Fig. 1		1.0		1.1	Non-breeding season 100 ind South
	Birds	Richness	Fig. 1		1.0		1.1	Non-breeding season 200 ind South
	Birds	Richness	Fig. 1		1.0		1.1	Non-breeding season 50 ind South
Edgar & Robertson 1992	Animals	Richness	Fig 2		1.0		1.3	Full seagrass density
	Animals	Abundance all	Fig 2		1.0		1.7	Full seagrass density
	Animals/seagrass	Abundance all	Fig 2		1.0		1.7	Full seagrass density
	Animals	Richness	Fig 2		1.0		1.6	Thinning seagrass density
	Total animals	Abundance all	Fig 2		1.0		3.1	Thinning seagrass density
	Total animals/g seagrass	Abundance all	Fig 2		1.0		1.6	Thinning seagrass density
Gribben et al 2009	Algae	Richness	Fig. 3	1.0	1.1	1.2	1.4	Caged
	Invertebrates	Abundance all	Fig. 3	1.0	1.4	1.9	1.9	Caged
	Invertebrates	Richness	Fig. 3	1.0	1.2	1.7	1.3	Caged
	Total Biomass	Abundance all	Fig. 3	1.0	2.5	2.9	2.2	Caged
	Total species	Richness	Fig. 3	1.0	1.1	1.4	1.4	Caged
	Algae	Richness	Fig. 3	1.0	1.5	1.8	1.9	No cage
	Invertebrate abundance	Abundance all	Fig. 3	1.0	3.4	3.8	5.7	No cage
	Invertebrate	Richness	Fig. 3	1.0	1.3	2.4	2.5	No cage
	Total Biomass	Abundance all	Fig. 3	1.0	0.7	0.1	0.3	No cage

	Total species s	Richness	Fig. 3	1.0	1.4	2.1	2.1	No cage
Hall & Bell	Crustacean nauplii	Abundance group	Table 1	1.0		1.6		artificial epiphytes+/- (0 vs. high)
1988	HarpacticoidS	Abundance group	Table 1	1.0		2.7		artificial epiphytes+/- (0 vs. high)
	Nematodes	Abundance group	Table 1	1.0		11.1		artificial epiphytes+/- (0 vs. high)
	Polychaetes	Abundance group	Table 1	1.0		18.1		artificial epiphytes+/- (0 vs. high)
Martin-Smith	All crustaceans	Abundance group	Fig. 4	1.0		3.3		2 wk Rope
1993	All crustaceans	Abundance group	Fig. 4	1.0		1.3		4 wk Rope
	All crustaceans	Abundance group	Fig. 4	1.0		0.8		6 wk Rope
	Gammarids	Abundance group	Fig. 4	1.0		5.9		2 wk Rope
	Gammarids	Abundance group	Fig. 4	1.0		3.4		4 wk Rope
	Gammarids	Abundance group	Fig. 4	1.0		2.8		6 wk Rope
	Gastropods	Abundance group	Fig. 5	1.0		7.6		2 wk Rope
	Gastropods	Abundance group	Fig. 5	1.0		3.6		4 wk Rope
	Gastropods	Abundance group	Fig. 5	1.0		1.5		6 wk Rope
	Polychaetes	Abundance group	Fig. 5	1.0		0.8		2 wk Rope
	Polychaetes	Abundance group	Fig. 5	1.0		1.0		4 wk Rope
	Polychaetes	Abundance group	Fig. 5	1.0		1.3		6 wk Rope
	All crustaceans	Abundance group	Fig. 4	1.0		1.6		2 wk Shad cloth
	All crustaceans	Abundance group	Fig. 4	1.0		1.7		4 wk Shad cloth
	All crustaceans	Abundance group	Fig. 4	1.0		1.0		6 wk Shad cloth
	Gammarids	Abundance group	Fig. 4	1.0		2.2		2 wk Shad cloth
	Gammarids	Abundance group	Fig. 4	1.0		3.1		4 wk Shad cloth
	Gammarids	Abundance group	Fig. 4	1.0		1.4		6 wk Shad cloth
	Gastropods	Abundance group	Fig. 5	1.0		5.6		2 wk Shad cloth
	Gastropods	Abundance group	Fig. 5	1.0		5.9		4 wk Shad cloth
	Gastropods	Abundance group	Fig. 5	1.0		0.8		6 wk Shad cloth
	Polychaetes	Abundance group	Fig. 5	1.0		0.1		2 wk Shad cloth
	Polychaetes	Abundance group	Fig. 5	1.0		1.5		4 wk Shad cloth
	Polychaetes	Abundance group	Fig. 5	1.0		0.6		6 wk Shad cloth
Ellwood &	Invertebrates	Abundance all (g/ha)	Txt p. 550	1.0	1.0			g/ha
2004	Invertebrates	Abundance all (g/m2)	Txt p. 549	1.0	120.0			g/m2
Stuntz 2001	Ants Ind/tree	Abundance group	Table 6.2	1.0		1.4		Dimerandra epiphyte Median
	Ants Taxa/tree	Abundance group	Table 6.2	1.0		1.0		Dimerandra epiphyte Median

Median					
Ants Ind/tree	Abundance group	Table 6.2	1.0	2.5	Tillanasta epiphyte Median
Ants Taxa/tree	Abundance group	Table 6.2	1.0	0.8	Tillanasta epiphyte Median
Ants Ind/tree	Abundance group	Table 6.2	1.0	1.9	Vriesa epiphyte Median
Ants Taxa/tree	Abundance group	Table 6.2	1.0	1.1	Vriesa epiphyte Median
spiders Ind/tree	Abundance group	Table 8.2	1.0	1.2	Dimerandra epiphyte Median
spiders Taxa/tree	Abundance group	Table 8.2	1.0	1.1	Dimerandra epiphyte Median
spiders Ind/tree	Abundance group	Table 8.2	1.0	1.1	Tillanasta epiphyte Median
spiders Taxa/tree	Abundance group	Table 8.2	1.0	1.2	Tillanasta epiphyte Median
spiders Ind/tree	Abundance group	Table 8.2	1.0	0.9	Vriesa epiphyte Median
spiders Taxa/tree	Abundance group	Table 8.2	1.0	0.9	Vriesa epiphyte Median

Figure S1. Photos of typical basal invertebrates and intermediate seaweed in estuarine habitat cascades.

Top left: Invasive *Gracilaria vermiculophylla* incorporated into native blue mussel *Mytilus edulis* in Danish estuaries. Top right: Native *Gracilaria chilensis* attached to native New Zealand cockle *Austrovenus stutchburyi* in Pauapatunui Inlet, New Zealand. Bottom left: Native *Gracilaria comosa* attached to invasive mudsnail *Batillaria australis*, in Swan River, Western Australia. Bottom right: Invasive *Gracilaria vermiculophylla* incorporated into tubes of native plumeworm *Diopatra cuprea* at the Eastern Shore of Virginia, USA.

Figure S2. Photos illustrating the habitat cascade at the Eastern shore of Virginia

Conversion of barren mudflats to seaweed habitats mediated by a polychaete habitat former at the eastern shore of Virginia. The polychaete tubes (basal habitat) and seaweed meadows (intermediate habitat) each support numerous habitat-utilizing focal organisms. Top left: Non-vegetated mudflat lacking biogenic habitat formers. Top right: Mudflat characterized by abundant populations of the habitat forming polychaete *Diopatra cuprea*. Bottom left: Close-up of *Diopatra* mudflat showing numerous distinct "*Gracilaria vermiculophylla* gardens" (incorporated into sediment-surface protruding polychaete tubes). Bottom right: *Diopatra cuprea* with incorporated flagging tape into its tube (we added the tape as a substitute for *Gracilaria* for visual effects). Thus, the gardening behaviour of the native *Diopatra cuprea* facilitate the invasive *Gracilaria vermiculophylla* in Virginia.