

### Electronic Supplementary Material

#### Davenport et al. 2017 - Living shorelines support near-shore benthic communities in upper and lower Chesapeake Bay

**Table A1.** Mean values of water quality and sediment characteristics ( $\pm$  SE) by year and shoreline at Windy Hill. Year = year of sampling before (2010) or after (2011, 2012, 2013) living shoreline construction. Shore = shoreline type, of which B = bulkhead control shorelines; M = marsh control shorelines; I = impact (living) shorelines; n = number of replicates. % Fines = percent of fine sediments (silt and clay, < 62.5 $\mu$ m diameter), PSU = practical salinity units, Temp = temperature, DO = dissolved oxygen.

Year	Shore	n	% Sand	% Fines	Salinity (PSU)	Temp ( $^{\circ}$ C)	DO (mg/L)
2010	I	3	34.59	1.45	5.4 (0.0)	26.6 (0.2)	13.5 (0.3)
	B	7	86.73	1.67	5.4 (0.0)	26.1 (0.5)	14.8 (0.7)
	M	6	74.70	4.15	5.4 (0.1)	27.0 (0.3)	14.1 (0.3)
2011	I	6	49.98	15.33	3.6 (0.0)	30.3 (0.2)	6.5 (0.2)
	B	4	65.30	3.51	3.6 (0.0)	30.4 (0.4)	6.7 (0.3)
	M	4	50.68	15.17	3.7 (0.1)	29.5 (0.6)	5.3 (0.3)
2012	I	6	39.08	7.78	8.9 (0.0)	27.5 (0.1)	7.8 (0.1)
	B	3	90.23	4.03	9.0 (0.0)	26.5 (0.1)	7.9 (0.1)
	M	4	73.38	2.71	9.1 (0.0)	26.8 (0.1)	8.2 (0.1)
2013	I	6	55.71	4.34	5.7 (0.0)	27.6 (0.2)	9.0 (0.5)
	B	3	86.20	2.84	5.5 (0.2)	27.9 (0.4)	12.1 (0.5)
	M	4	58.05	11.94	5.4 (0.2)	27.6 (0.2)	10.8 (0.7)

**Table A2.** Mean density per m<sup>2</sup> and SE by shoreline type (impact, marsh or bulkhead control) and year at Windy Hill. Species are listed in order of most abundant to least abundant across all shoreline types. B = class Bivalvia, P = class Polychaeta, C = class Crustacea.

	2010						2011					
	Impact (= bulkhead)		Bulkhead		Marsh		Impact (= living shoreline)		Bulkhead		Marsh	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
<i>Limecola balthica</i> (B)	75.7	13.2	42.9	7.3	106.0	20.7	45.5	22.4	0.0	0.0	22.8	7.9
<i>Alitta succinea</i> (P)	481.8	236.6	131.2	61.0	206.1	59.3	33.3	12.1	25.0	2.3	50.0	17.6
<i>Rangia cuneata</i> (B)	0.0	0.0	2.6	1.7	0.0	0.0	1.5	1.5	27.3	3.7	25.0	10.1
<i>Ameritella mitchelli</i> (B)	15.2	15.2	24.7	3.8	59.1	21.0	25.8	13.4	65.9	24.2	75.0	51.1
Spionidae (P)	0.0	0.0	16.9	8.7	13.6	10.2	4.6	2.0	15.9	7.8	27.3	3.7
Capitellidae (P)	9.1	5.3	9.1	4.9	16.7	7.9	0.0	0.0	0.0	0.0	15.9	4.4
<i>Cyathura polita</i> (C)	6.1	3.0	2.6	2.6	1.5	1.5	3.0	1.9	4.6	4.6	2.3	2.3
<i>Etenoe heteropoda</i> (P)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mya arenaria</i> (B)	12.1	3.0	1.3	1.3	4.6	3.1	0.0	0.0	0.0	0.0	2.3	2.3
<i>Laoenereis culveri</i> (P)	3.0	3.0	2.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	2.3	2.3
<i>Edotea triloba</i> (C)	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nemertea	0.0	0.0	0.0	0.0	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0
	2012						2013					
<i>Limecola balthica</i> (B)	4.6	4.6	0.0	0.0	0.0	0.0	506.1	175.9	281.8	68.8	261.4	77.3
<i>Alitta succinea</i> (P)	27.3	10.0	18.2	13.9	77.3	42.4	112.1	35.4	12.1	8.0	106.8	43.0
<i>Rangia cuneata</i> (B)	172.8	34.6	193.9	68.5	265.9	45.7	10.6	4.3	12.1	8.0	13.7	4.6
<i>Ameritella mitchelli</i> (B)	31.8	15.3	12.1	8.0	18.2	11.1	60.6	27.7	121.2	25.9	72.7	29.7
Spionidae (P)	21.2	10.1	36.4	5.3	168.2	82.1	0.0	0.0	0.0	0.0	0.0	0.0



**Table A3.** Summary of analysis of variance at Windy Hill for (a) total  $\log_{10}(x+1)$  density /  $m^2$ , (b)  $\log_{10}(x+1)$  clam density /  $m^2$ , (c)  $\log_{10}(x+1)$  polychaete density /  $m^2$ , (d) total  $\log_{10}(x+1)$  biomass /  $m^2$ , (e)  $\log_{10}(x+1)$  clam biomass /  $m^2$ , (f)  $\log_{10}(x+1)$  polychaete biomass /  $m^2$ , and (g) taxa richness /  $0.11m^2$ . Summary of permutational multivariate analysis of variance (PERMANOVA) at Windy Hill for (h) square root transformed community composition, (i) square root transformed clam assemblage composition, and (j) square root transformed polychaete assemblage composition. Year = fixed effect of sampling year, Shore = fixed effect of shoreline (impact, marsh control and bulkhead control), Y x S = BACI interaction of year and shoreline fixed effects. DF = degrees of freedom, SS = sum of squares, MS = mean squares, F = F-ratio, Pseudo-F = Pseudo F-ratio, P = P-value.

(A)		Total density / $m^2$				
	DF	SS	MS	F	P	
Year	3	5.271	1.757	8.371	0.000	
Shore	2	0.720	0.360	1.715	0.192	
Yr x Shore	6	1.988	0.331	1.579	0.176	
Residuals	44	9.235	0.210			
(B)		Clams: density / $m^2$				
	DF	SS	MS	F	P	
Year	3	5.846	1.949	9.859	0.000	
Shore	2	0.836	0.418	2.115	0.133	
Yr x Shore	6	1.571	0.262	1.325	0.267	
Residuals	44	8.697	0.198			
(C)		Polychaetes: density / $m^2$				
	DF	SS	MS	F	P	
Year	3	5.224	1.741	7.562	0.000	
Shore	2	2.533	1.267	5.501	0.007	
Yr x Shore	6	3.676	0.613	2.661	0.027	
Residuals	44	10.131	0.230			
(D)		Total biomass / $m^2$				
	DF	SS	MS	F	P	
Year	3	1.580	0.527	11.712	<0.000	
Shore	2	0.143	0.071	1.585	0.217	
Yr x Shore	6	0.240	0.040	0.890	0.510	
Residuals	44	1.979	0.045			
(E)		Clams: biomass / $m^2$				
	DF	SS	MS	F	P	
Year	3	1.851	0.617	10.939	0.000	
Shore	2	0.065	0.032	0.572	0.569	
Yr x Shore	6	0.271	0.045	0.799	0.576	

Residuals	44	2.482	0.056		
(F)	Polychaetes: biomass / m <sup>2</sup>				
	DF	SS	MS	F	P
Year	3	0.091	0.030	3.092	0.037
Shore	2	0.112	0.056	5.677	0.006
Yr x Shore	6	0.125	0.021	2.120	0.070
Residuals	44	0.434	0.010		
(G)	Richness / 0.111 m <sup>2</sup>				
	DF	SS	MS	F	P
Year	3	35.171	11.724	6.245	0.001
Shore	2	3.375	1.687	0.899	0.414
Yr x Shore	6	37.413	6.235	3.322	0.009
Residuals	44	82.595	1.877		
(H)	Community composition				
	DF	SS	MS	Pseudo-F	P
Year	3	6.502	2.167	15.218	0.000
Shoreline	2	0.807	0.403	2.831	0.002
Yr x Shore	6	1.274	0.212	1.491	0.040
Residuals	44	6.267	0.142	0.422	
(I)	Clam assemblage composition				
	DF	SS	MS	Pseudo-F	P
Year	3	8.021	2.674	22.037	0.000
Shoreline	2	0.709	0.354	2.921	0.005
Yr x Shore	6	1.440	0.240	1.978	0.007
Residuals	44	5.338	0.121	0.344	
(J)	Polychaete assemblage composition				
	DF	SS	MS	Pseudo-F	P
Year	3	3.771	1.257	6.810	0.000
Shoreline	2	1.026	0.513	2.780	0.003
Yr x Shore	6	1.482	0.247	1.338	0.118
Residuals	44	8.121	0.185	0.564	

**Table A4.** Mean values of water quality and sediment characteristics ( $\pm$  SE) by year and shoreline at Lynnhaven. Year = year of sampling before (2012) or After (2013, 2014) living shoreline construction. Shore = shoreline type, of which M = marsh control shorelines; I = impact (living) shorelines. n = number of replicates, % Fines = percent of fine sediments (silt and clay, < 62.5 $\mu$ m diameter), PSU = practical salinity units, Temp = temperature, DO = dissolved oxygen.

Year	Type	n	% Sand	% Fines	Salinity (PSU)	Temp ( $^{\circ}$ C)	DO (mg/L)
2012	I	6	19.59	80.42	18.7 (0.0)	26.6 (0.0)	6.4 (0.0)
	M	6	12.46	87.57	18.4 (0.0)	28.3 (0.0)	7.4 (0.0)
2013	I	6	1.87	98.13	19.2 (0.0)	25.5 (0.1)	6.5 (0.1)
	M	6	0.53	99.47	18.9 (0.0)	27.2 (0.2)	7.4 (0.3)
2014	I	6	11.60	88.42	19.4 (0.0)	26.6 (0.0)	5.0 (0.0)
	M	6	14.31	85.70	19.3 (0.0)	28.2 (0.0)	6.9 (0.0)



**Table A6.** Summary of analysis of variance at Lynnhaven for (a) total  $\log_{10}(x+1)$  density /  $m^2$ , (b)  $\log_{10}(x+1)$  clam density /  $m^2$ , (c)  $\log_{10}(x+1)$  polychaete density /  $m^2$ , (d) total  $\log_{10}(x+1)$  biomass /  $m^2$ , (e)  $\log_{10}(x+1)$  clam biomass /  $m^2$ , (f)  $\log_{10}(x+1)$  polychaete biomass /  $m^2$ , and (g) taxa richness /  $0.11m^2$ . Summary of permutational multivariate analysis of variance (PERMANOVA) at Lynnhaven for (h) square root transformed community composition, (i) square root transformed clam assemblage composition, and (j) square root transformed polychaete assemblage composition. Year = fixed effect of sampling year, Shore = fixed effect of shoreline (impact, marsh control and bulkhead control), Y x S = BACI interaction of year and shoreline fixed effects. DF = degrees of freedom, SS = sum of squares, MS = mean squares, F = F-ratio, Pseudo-F = Pseudo F-ratio, P = P-value.

(A)	Total density / $m^2$				
	DF	SS	MS	F	P
Year	2	0.250	0.125	4.586	0.018
Shore	1	0.081	0.081	2.965	0.095
Yr x Shore	2	0.096	0.048	1.761	0.189
Residuals	30	0.817	0.027		
(B)	Clams: density / $m^2$				
	DF	SS	MS	F	P
Year	2	1.337	0.668	8.474	0.001
Shore	1	0.027	0.027	0.338	0.566
Yr x Shore	2	0.238	0.119	1.508	0.238
Residuals	30	2.366	0.079		
(C)	Polychaetes: density / $m^2$				
	DF	SS	MS	F	P
Year	2	0.558	0.279	2.862	0.073
Shore	1	0.578	0.578	5.929	0.021
Yr x Shore	2	0.874	0.437	4.486	0.020
Residuals	30	2.923	0.097		
(D)	Total biomass / $m^2$				
	DF	SS	MS	F	P
Year	2	0.870	0.435	6.225	0.005
Shore	1	0.007	0.007	0.095	0.760
Yr x Shore	2	0.224	0.112	1.602	0.218
Residuals	30	2.097	0.070		
(E)	Clams: biomass / $m^2$				
	DF	SS	MS	F	P
Year	2	2.191	1.096	6.895	0.003
Shore	1	0.133	0.133	0.834	0.368



Yr x Shore	2	0.459	0.229	1.444	0.252
Residuals	30	4.767	0.159		
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(F)	Polychaetes: biomass / m <sup>2</sup>				
	DF	SS	MS	F	P
Year	2	0.099	0.050	5.821	0.007
Shore	1	0.028	0.028	3.300	0.079
Yr x Shore	2	0.018	0.009	1.062	0.358
Residuals	30	0.255	0.009		
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(G)	Richness / 0.111 m <sup>2</sup>				
	DF	SS	MS	F	P
Year	2	11.167	5.583	5.646	0.008
Shore	1	4.000	4.000	4.045	0.053
Yr x Shore	2	3.167	1.583	1.601	0.218
Residuals	30	29.667	0.989		
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(H)	Community composition				
	DF	SS	MS	Pseudo-F	P
Year	2	0.968	0.484	5.216	0.000
Shoreline	1	0.211	0.211	2.272	0.052
Yr x Shore	2	0.331	0.165	1.780	0.074
Residuals	30	2.785	0.093	0.648	
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(I)	Clam assemblage composition				
	DF	SS	MS	Pseudo-F	P
Year	2	1.102	0.551	6.577	0.000
Shoreline	1	0.126	0.126	1.505	0.199
Yr x Shore	2	0.160	0.080	0.957	0.439
Residuals	30	2.513	0.084	0.644	
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(J)	Polychaete assemblage composition				
	DF	SS	MS	Pseudo-F	P
Year	2	1.066	0.533	3.725	0.002
Shoreline	1	0.260	0.260	1.819	0.124
Yr x Shore	2	0.486	0.243	1.700	0.104
Residuals	30	4.291	0.143	0.703	