Supplementary Information

Landscape sediment characteristics were assessed within four biogeographic zones (reef flat, fore reef, tidal channel and seagrass meadow) in the coastal waters adjacent to Zanzibar Town, Tanzania. The upper 5-10 cm of sediment was collected using a *Van Veen* sampler (3 mm plate, 250 cm^2) at 27 locations following the bathymetric gradient and covering the four biogeographic areas. Sedimentary samples were rinsed with clean freshwater in order to remove soluble components and dried at 40°C for at least 48h. Two subsamples (of each set) were sieved in a stack-shaker sieve for 10 min. We applied the Udden-Wentworth scale (Wentworth 1922) as following: gravel (>2000 μm), coarse sand (1000-2000 μm), medium sand (500-1000 μm), medium-fine sand (250-500 μm), fine sand (125-250 μm), very fine sand (63-125 μm) and silt (<63 μm). Each individual fraction was calculated as weight percentage of the total bulk sediment. We used the logarithmic Folk and Ward (1957) method to convert the measurements into phi scale, and the physical description of sediments was based on the granulometric output and appearance of the bulk sediment after Folk (1954). Summary statistics for each zone were estimated from log-transformed data using the G2Sd R package (Fournier et al. 2014).

Table S1. Landscape sediment characteristics of the four biogeographic zones.

Zone	**Reef Flat**	**Fore Reef**	**Tidal Channel**	**Seagrass**
Mean grain size (μm)	2818	2352	2546	1953
Mean grain size (phi)	0.539	0.631	0.432	0.656
SD grain size (phi)	1.105	1.129	1.347	1.252
Skewness	-0.379	-0.295	-0.107	-0.052
Kurtosis	1.137	1.025	0.987	0.965
Sorting	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted
Texture	Gravelly Sand	Gravelly Sand	Gravelly Sand	Gravelly Sand
% Gravel	15.4	13.6	16.8	14.8
% Sand	84.1	85.6	82.1	84.4
% Mud (>63 μm)	0.5	0.8	1.1	0.7

The texture of the four biogeographic zones was consistently classified as gravelly sand; however, the mean grain size was slightly smaller within seagrass meadows (1953 μm) when compared to the reef flat (2818 μm), fore reef (2352 μm) or sediments found on deeper areas of the channel (2546 μm). There were no major (compositional or granumetrical) differences among the four bioregions, with all classified as poorly-sorted, gravelly sand. All regions contained approximately 15% gravel, 84% sand and 1% mud (Supplementary Table 1).

To qualitatively assess local sediment characteristics of the 5 seagrass communities, high-resolution images were taken of a representative sample of surface sediments (top 2-3 cm) from each community (Supplementary Figure 1) and qualitatively compared based on appearance and texture (Folk, 1954). We found no large qualitative visual differences among surface sediments beneath the different seagrass communities, and all were consistent with the sediment characterization of the region (poorly-sorted, gravelly sand).

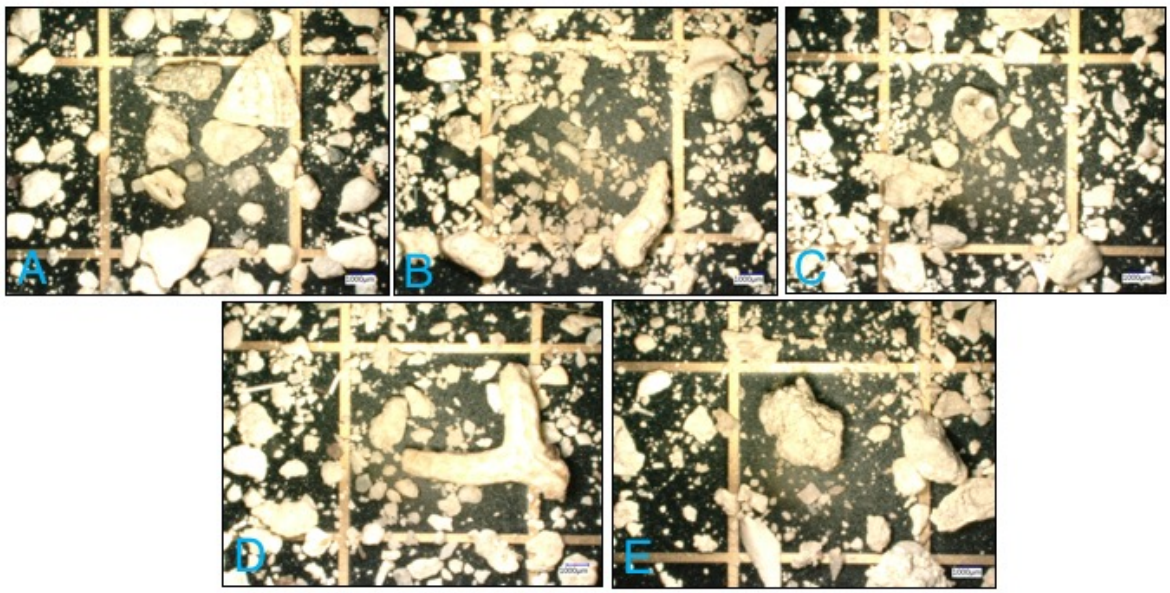

Fig. S1. Images of representative sediments from each seagrass community (A-E), laid over a 5-mm grid.

Table S2. Tukey post hoc results for above ground biomass analysis for comparisons a) among communities, b) among meadows, and c) within communities among meadow. Results reported are the difference between groups, lower and upper 95% confidence intervals, and the adjusted *p*-values, with statistical difference at the significance level $p \leq 0.05$.

a) Comparisons among communities				
Comparison	difference	lower	upper	adj. p
B-A	1.825	1.060	2.590	<0.001
C-A	-1.406	-1.984	-0.828	<0.001
D-A	-0.748	-1.364	-0.131	0.011
E-A	-0.754	-1.332	-0.176	0.005
C-B	-3.231	-3.939	-2.523	<0.001
D-B	-2.572	-3.312	-1.833	<0.001
E-B	-2.579	-3.287	-1.871	<0.001
D-C	0.658	0.114	1.203	0.011
E-C	0.652	0.151	1.153	0.005
E-D	-0.007	-0.551	0.538	1.000
b) Comparisons among meadows				
Comparison	difference	lower	upper	adj. p
M2-M1	-0.184	-0.572	0.204	0.486
M3-M1	0.547	0.145	0.949	0.005
M3-M2	0.731	0.356	1.107	<0.001
c) Comparisons within communities among meadows				
Comparison	difference	lower	upper	adj. p
A: M2-M1	-0.265	-1.680	1.150	1.000
A: M3-M1	0.699	-0.716	2.114	0.892
A: M3-M2	0.964	-0.450	2.379	0.490
B: M2-M1	-1.312	-2.894	0.270	0.200
B: M3-M1	-	-	-	-

B: M3-M2	-	-	-	-
C: M2-M1	0.225	-1.000	1.450	1.000
C: M2-M1	0.910	-0.315	2.135	0.353
C: M3-M2	0.685	-0.316	1.685	0.483
D: M2-M1	-0.675	-2.257	0.906	0.962
D: M3-M1	0.330	-1.085	1.745	1.000
D: M3-M2	1.005	-0.220	2.231	0.214
E: M2-M1	0.261	-0.739	1.262	1.000
E: M3-M1	0.749	-0.476	1.975	0.660
E: M3-M2	0.488	-0.737	1.714	0.978

Table S3. Tukey post hoc results for below ground biomass analysis for comparisons a) among communities, b) among meadows, and c) within communities among meadow. Results reported are the difference between groups, lower and upper 95% confidence intervals, and the adjusted *p*-values, with sstatistical difference at the significance level $p \leq 0.05$.

a) Comparisons among communities				
Comparison	difference	lower	upper	adj. p
B-A	0.979	0.312	1.646	0.001
C-A	-0.235	-0.739	0.270	0.676
D-A	0.091	-0.447	0.629	0.989
E-A	0.506	0.002	1.010	0.049
C-B	-1.213	-1.831	-0.596	<0.001
D-B	-0.888	-1.533	-0.243	0.003
E-B	-0.473	-1.091	0.145	0.206
D-C	0.326	-0.149	0.800	0.305
E-C	0.740	0.304	1.177	<0.001
E-D	0.415	-0.060	0.890	0.112
b) Comparisons among meadows				
Comparison	difference	lower	upper	adj. p
M2-M1	-0.328	-0.666	0.011	0.059
M3-M1	0.003	-0.347	0.353	1.000
M3-M2	0.331	0.003	0.658	0.047
c) Comparisons within communities among meadows				
Comparison	difference	lower	upper	adj. p
A: M2-M1	-0.564	-1.797	0.670	0.937
A: M3-M1	0.197	-1.037	1.431	1.000
A: M3-M2	0.760	-0.473	1.994	0.649
B: M2-M1	-0.214	-1.594	1.165	1.000
B: M3-M1	-	-	-	-
B: M3-M2	-	-	-	-
C: M2-M1	-0.607	-1.676	0.461	0.759
C: M2-M1	0.345	-0.724	1.414	0.997
C: M3-M2	0.852	0.080	1.825	0.081
D: M2-M1	-0.424	-1.803	0.955	0.998
D: M3-M1	-0.528	-1.761	0.706	0.962
D: M3-M2	-0.104	-1.172	0.965	1.000
E: M2-M1	0.024	-0.849	0.896	1.000

E: M3-M1	-0.249	-1.317	0.820	1.000
E: M3-M2	-0.272	-1.341	0.796	1.000

Table S4. ANOVA outputs (df=degrees of freedom, SS=sum of squares, F=F-value, and p=p-value) for explanatory models of response variables: percent OC in top 25 cm of sediment, storage of OC in the top 25 cm, and storage in the top 1 m of sediment. A suite of models was evaluated that included explanatory variables: community, meadow, and their interaction.

Description	Response	Explanatory	df	SS	F	p
Explanatory models comparing only communities with seagrass (A-E) and the three meadows (M1, M2, M3).	% OC top 25cm ~	community	4	0.0211	1.340	0.327
		meadow	2	0.0249	3.163	0.091
		residuals	9	0.0354		
Explanatory models comparing all communities (A-F; with seagrass and bare sediment) and the three meadows (M1, M2, M3).	% OC top 25cm ~	community	5	0.1311	6.973	0.004
		meadow	2	0.0238	3.169	0.082
		residuals	11	0.0414		
Explanatory models comparing only communities with seagrass (A-E) and the three meadows (M1, M2, M3).	OC stock 25cm ~	community	4	16.87	1.425	0.302
		meadow	2	29.90	3.352	0.082
		residuals	9	26.63		
Explanatory models comparing all communities (A-F; with seagrass and bare sediment) and the three meadows (M1, M2, M3).	OC stock 25cm ~	community	5	126.94	7.963	0.002
		meadow	2	31.04	3.668	0.060
		residuals	11	35.07		
Explanatory models comparing only communities with seagrass (A-E) and the three meadows (M1, M2, M3).	OC stock 1m ~	community	4	71.00	0.196	0.934
		meadow	2	0.700	0.004	0.996
		residuals	9			
Explanatory models comparing all communities (A-F; with seagrass and bare sediment) and the three meadows (M1, M2, M3).	OC stock 1m ~	community	5	607.3	1.448	0.282
		meadow	2	13.47	0.161	0.854
		residuals	11	922.4		

Table S5. Validation of the model assumption of normality (Shapiro-Wilk) for all sediment OC models. Models were also validated visually with plots of model residuals (fitted values vs absolute residuals (homogeneity of variance), a qqplot comparing the distribution of the standardized residuals to the normal distribution (normality), and a lag plot of the raw residuals vs the previous residual (independence).

	Response	Explanatory	Shapiro-Wilk
Only w/seagrass	% OC top 25cm ~	comm + mead	W=0.963, p=0.721
all	% OC top 25cm ~	comm + mead	W=0.960, p=0.589
Only w/seagrass	OC stock 25cm ~	comm + mead	W=0.944, p=0.403
all	OC stock 25cm ~	comm + mead	W=0.946, p=0.338
Only w/seagrass	OC stock 1m ~	comm + mead	W=0.940, p=0.358
all	OC stock 1m ~	comm + mead	W=0.936, p=0.226

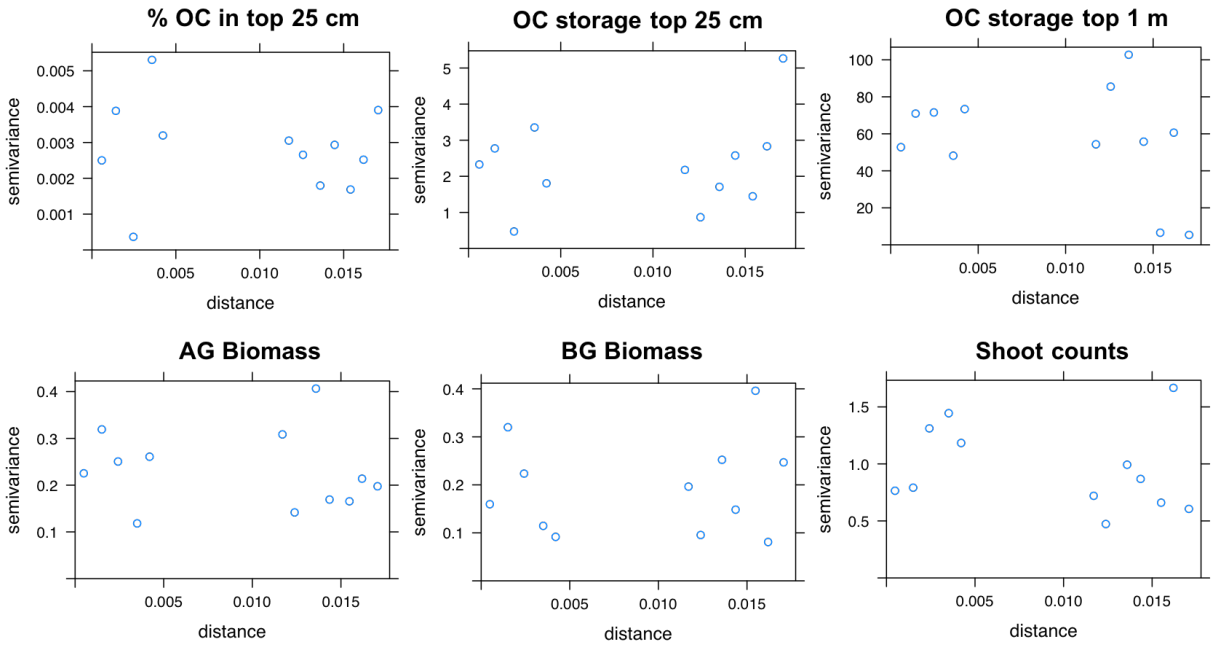

Fig. S2. Variogram plots of residuals for models based on ANOVA/glm with community as the explanatory variable. Distance is great-circle distance in km and semivariance is a measure of spatial correlation between points at different distances. For simplicity, we show plots from global models, directional variograms were also plotted and checked but did not show patterns either.