Supplementary information for Cagle et al., *Planting Spartina alterniflora in a salt marsh denuded of vegetation by an oil spill induces a rapid response in the soil microbial community.*

Supplementary table 1. Results of the test of *Spartina alterniflora* transplants, fertilizer, and their interaction on soil microbial community dispersion by PERMDISP (Anderson, 2006). Dispersion is the average distance, in the space of the UniFrac dissimilarity of microbial community composition, of samples to the spatial median of their treatment group.

	Df	Sum Sq	Mean Sq	F	N.Perm	Pr(>F)
2 months (June 2014)						
Treatment	3	0.002	0.001	0.407	9999	0.763
Residual	16	0.023	0.001	NA	NA	NA
7 months (November 2014)						
Treatment	3	0.022	0.007	5.419	9999	0.007
Residual	16	0.022	0.001	NA	NA	NA
13 months (May 2015)						
Treatment	3	0.000	0.000	0.021	9999	0.996
Residual	16	0.030	0.002	NA	NA	NA
19 months (November 2015)						
Treatment	3	0.002	0.001	0.772	9999	0.550
Residual	13	0.009	0.001	NA	NA	NA
26 months (June 2016)						
Treatment	3	0.005	0.002	1.104	9999	0.382
Residual	12	0.019	0.002	NA	NA	NA

Supplementary table 2. Pairwise contrasts of microbial community dispersion at the sampling point seven months after initiating the experiment. Dispersion is the average distance, in the space of the UniFrac dissimilarity of microbial community composition (Lozupone and Knight, 2005), of samples to the spatial median of their treatment group. The treatments include: no transplants plus fertilizer; no transplants and no fertilizer; *Spartina alterniflora* transplants plus fertilizer; and *S. alterniflora* transplants and no fertilizer. A Tukey adjustment was applied to correct for multiple comparisons.

	diff	lwr	upr	p adj
Not planted Unfertilized vs Not planted Fertilized	-0.069	-0.135	-0.002	0.041
Spartina Fertilized vs Not planted Fertilized	-0.081	-0.147	-0.014	0.015
Spartina Unfertilized vs Not planted Fertilized	-0.078	-0.144	-0.011	0.019
Spartina Fertilized vs Not planted Unfertilized	-0.012	-0.078	0.055	0.956
Spartina Unfertilized vs Not planted Unfertilized	-0.009	-0.075	0.057	0.980
Spartina Unfertilized vs *Spartina* Fertilized	0.003	-0.064	0.069	0.999

Supplementary table 3. The mean and standard deviation of the environmental variables measured during the experiment. Samples were collected from a 60 × 60 cm quadrat placed at a different position inside each treatment plot at each sampling date.

Treatment	*Spartina* stems m^{-2}	*Spartina* biomass g m^{-2}	*Distichlis* stems m^{-2}	*Distichlis* biomass g m^{-2}	Total biomass g m^{-2}	Total dead biomass g m^{-2}	Belowground biomass g dm^{-3}	pH	Nitrate µg g dry $soil^{-1}$	Ammonium µg g dry $soil^{-1}$
2 months										
Not planted, Unfertilized	0.0 (0.0)	0.0 (0.0)	48.8 (79.9)	7.9 (11.5)	7.9 (11.5)	0.0 (0.0)	0.0 (0.0)	6.3 (0.6)	0.4 (0.3)	4.8 (3.9)
Not planted, Fertilized	12.0 (20.8)	5.1 (10.8)	58.4 (80.0)	9.0 (12.4)	14.2 (12.5)	0.0 (0.0)	0.0 (0.0)	6.2 (0.4)	0.5 (0.5)	9.6 (1.8)
Spartina, Unfertilized	146.8 (50.7)	242.8 (90.5)	0.0 (0.0)	0.0 (0.0)	242.8 (90.5)	9.8 (10.7)	0.1 (0.1)	6.3 (0.5)	0.3 (0.2)	4.4 (2.1)
Spartina, Fertilized	180.6 (42.3)	305.9 (102.7)	0.0 (0.0)	0.0 (0.0)	305.9 (102.7)	8.1 (7.3)	0.1 (0.2)	6.2 (0.6)	0.2 (0.2)	3.8 (1.7)
7 months										
Not planted, Unfertilized	76.8 (64.0)	114.4 (94.6)	641.6 (503.8)	149.9 (127.3)	264.3 (141.8)	18.9 (14.2)	0.8 (1.1)	4.9 (0.6)	0.4 (0.2)	2.4 (0.7)
Not planted, Fertilized	81.6 (124.3)	120.6 (195.5)	1,006.4 (926.5)	256.7 (247.8)	377.3 (153.0)	72.5 (50.6)	1.4 (1.3)	5.1 (0.6)	0.4 (0.2)	2.2 (0.7)
Spartina, Unfertilized	197.8 (31.6)	501.7 (88.6)	16.8 (37.6)	9.0 (20.0)	510.7 (87.8)	193.5 (96.3)	3.3 (1.8)	5.7 (1.1)	0.4 (0.3)	2.1 (0.4)
Spartina, Fertilized	295.0 (28.4)	859.1 (146.5)	0.0 (0.0)	0.0 (0.0)	859.1 (146.5)	187.7 (82.0)	5.1 (1.9)	5.5 (0.4)	0.4 (0.1)	2.5 (1.2)
13 months										
Not planted, Unfertilized	114.0 (74.5)	219.5 (151.7)	570.8 (421.7)	332.5 (234.2)	552.0 (100.9)	120.2 (101.8)	2.2 (1.4)	5.5 (1.5)	0.0 (0.0)	1.4 (0.4)
Not planted, Fertilized	93.4 (90.7)	335.6 (363.5)	638.8 (542.0)	373.3 (367.9)	708.9 (260.1)	123.7 (82.1)	5.8 (2.7)	5.8 (1.1)	0.2 (0.1)	2.9 (0.7)
Spartina, Unfertilized	131.0 (8.2)	495.3 (158.6)	70.6 (79.6)	87.4 (108.3)	582.8 (69.1)	266.8 (114.8)	4.2 (1.3)	5.7 (0.8)	0.1 (0.1)	1.9 (1.4)
Spartina, Fertilized	177.2 (26.8)	1,004.1 (197.9)	62.4 (89.8)	81.2 (100.1)	1,085.2 (192.6)	359.8 (120.4)	7.1 (2.1)	6.0 (0.7)	0.1 (0.1)	1.5 (0.8)
19 months										
Not planted, Unfertilized	10.4 (16.7)	28.0 (45.1)	246.6 (311.8)	195.6 (214.6)	226.0 (192.5)	348.2 (137.1)	5.0 (2.0)	6.7 (0.4)	0.1 (0.1)	2.7 (1.0)
Not planted, Fertilized	25.8 (18.6)	92.4 (137.9)	252.2 (393.0)	173.8 (351.5)	278.7 (485.4)	352.9 (146.4)	7.3 (2.3)	6.8 (0.3)	0.1 (0.1)	2.4 (0.7)
Spartina, Unfertilized	71.8 (18.6)	308.8 (184.8)	192.2 (256.3)	57.9 (86.8)	374.5 (226.2)	349.1 (130.7)	6.0 (4.0)	7.2 (0.4)	0.1 (0.1)	1.9 (0.2)
Spartina, Fertilized	96.0 (41.1)	646.4 (153.8)	51.8 (79.7)	12.2 (19.7)	664.8 (153.3)	344.5 (118.9)	8.9 (3.0)	7.1 (0.3)	0.1 (0.1)	2.2 (0.6)
26 months										
Not planted, Unfertilized	19.5 (19.1)	33.0 (38.1)	1,469.5 (738.9)	662.8 (450.6)	695.9 (412.5)	298.4 (110.9)	3.3 (0.2)	6.8 (0.6)	0.3 (0.1)	3.5 (0.8)
Not planted, Fertilized	84.5 (41.6)	169.7 (126.4)	229.8 (425.3)	138.8 (273.0)	308.5 (387.2)	72.6 (99.1)	3.8 (1.9)	7.2 (0.4)	0.2 (0.1)	13.3 (15.5)
Spartina, Unfertilized	131.0 (45.8)	189.6 (103.1)	280.6 (535.0)	94.9 (187.2)	284.8 (260.3)	78.8 (98.7)	5.3 (3.7)	6.9 (0.5)	0.3 (0.3)	4.8 (1.5)
Spartina, Fertilized	290.2 (34.9)	583.7 (165.2)	25.0 (50.0)	7.8 (15.7)	591.5 (175.4)	93.7 (76.7)	4.4 (2.1)	6.9 (0.1)	0.2 (0.1)	5.5 (1.4)

Supplementary table 4. Results of ANOVA of alpha diversity in terms of the inverse Simpson metric. The treatments included: no transplants plus fertilizer; no transplants and no fertilizer; *Spartina alterniflora* transplants plus fertilizer; and *S. alterniflora* transplants and no fertilizer. There were five sampling dates over the course of the experiment.

	SS	MS	NumDF	DenDF	F	Pr(>F)
Plant	46.959	46.959	1	71.400	8.902	0.004
Fertilizer	0.156	0.156	1	71.520	0.030	0.864
SamplingDate	96.529	24.132	4	71.130	4.575	0.002
Plant:Fertilizer	0.066	0.066	1	71.400	0.013	0.911
Plant:SamplingDate	101.026	25.256	4	71.258	4.788	0.002
Fertilizer:SamplingDate	97.459	24.365	4	71.311	4.619	0.002
Plant:Fertilizer:SamplingDate	112.531	28.133	4	71.258	5.333	0.001

Supplementary table 5. Contrasts of alpha diversity, in terms of the inverse Simpson metric, between treatments. The contrasts of interest were specified *a priori* and included differences among the treatments at each time point and within-treatment differences over time.

Plant	Fertilizer	SamplingDate	contrast	estimate	SE	df	t.ratio	p.value
Not_planted	Fertilized	.	2014-06-20 - 2014-11-15	-4.597	1.453	71.001	-3.165	0.160
Not_planted	Fertilized	.	2014-06-20 - 2015-05-27	-8.735	1.453	71.001	-6.013	0.000
Not_planted	Fertilized	.	2014-06-20 - 2015-11-12	-4.099	1.453	71.001	-2.822	0.433
Not_planted	Fertilized	.	2014-06-20 - 2016-06-17	-7.996	1.545	71.413	-5.174	0.000
Not_planted	Fertilized	.	2014-11-15 - 2015-05-27	-4.138	1.453	71.001	-2.849	0.402
Not_planted	Fertilized	.	2014-11-15 - 2015-11-12	0.498	1.453	71.001	0.343	1.000
Not_planted	Fertilized	.	2014-11-15 - 2016-06-17	-3.399	1.545	71.413	-2.199	1.000
Not_planted	Fertilized	.	2015-05-27 - 2015-11-12	4.636	1.453	71.001	3.192	0.148
Not_planted	Fertilized	.	2015-05-27 - 2016-06-17	0.739	1.545	71.413	0.478	1.000
Not_planted	Fertilized	.	2015-11-12 - 2016-06-17	-3.897	1.545	71.413	-2.522	0.974
Spartina	Fertilized	.	2014-06-20 - 2014-11-15	-0.211	1.453	71.001	-0.145	1.000
Spartina	Fertilized	.	2014-06-20 - 2015-05-27	0.459	1.453	71.001	0.316	1.000
Spartina	Fertilized	.	2014-06-20 - 2015-11-12	-0.523	1.453	71.001	-0.360	1.000
Spartina	Fertilized	.	2014-06-20 - 2016-06-17	-1.908	1.545	71.413	-1.235	1.000
Spartina	Fertilized	.	2014-11-15 - 2015-05-27	0.671	1.453	71.001	0.462	1.000
Spartina	Fertilized	.	2014-11-15 - 2015-11-12	-0.311	1.453	71.001	-0.214	1.000
Spartina	Fertilized	.	2014-11-15 - 2016-06-17	-1.697	1.545	71.413	-1.098	1.000
Spartina	Fertilized	.	2015-05-27 - 2015-11-12	-0.982	1.453	71.001	-0.676	1.000
Spartina	Fertilized	.	2015-05-27 - 2016-06-17	-2.367	1.545	71.413	-1.532	1.000
Spartina	Fertilized	.	2015-11-12 - 2016-06-17	-1.385	1.545	71.413	-0.896	1.000
Not_planted	Unfertilized	.	2014-06-20 - 2014-11-15	-1.777	1.453	71.001	-1.223	1.000
Not_planted	Unfertilized	.	2014-06-20 - 2015-05-27	2.303	1.546	71.431	1.490	1.000
Not_planted	Unfertilized	.	2014-06-20 - 2015-11-12	-1.536	1.453	71.001	-1.058	1.000
Not_planted	Unfertilized	.	2014-06-20 - 2016-06-17	-4.864	1.689	71.917	-2.880	0.367
Not_planted	Unfertilized	.	2014-11-15 - 2015-05-27	4.080	1.546	71.431	2.640	0.713
Not_planted	Unfertilized	.	2014-11-15 - 2015-11-12	0.241	1.453	71.001	0.166	1.000
Not_planted	Unfertilized	.	2014-11-15 - 2016-06-17	-3.087	1.689	71.917	-1.828	1.000
Not_planted	Unfertilized	.	2015-05-27 - 2015-11-12	-3.839	1.546	71.431	-2.484	1.000
Not_planted	Unfertilized	.	2015-05-27 - 2016-06-17	-7.167	1.761	71.524	-4.070	0.008
Not_planted	Unfertilized	.	2015-11-12 - 2016-06-17	-3.328	1.689	71.917	-1.970	1.000
Spartina	Unfertilized	.	2014-06-20 - 2014-11-15	-2.216	1.453	71.001	-1.525	1.000
Spartina	Unfertilized	.	2014-06-20 - 2015-05-27	-0.093	1.453	71.001	-0.064	1.000
Spartina	Unfertilized	.	2014-06-20 - 2015-11-12	-1.255	1.453	71.001	-0.864	1.000
Spartina	Unfertilized	.	2014-06-20 - 2016-06-17	2.153	1.453	71.001	1.482	1.000
Spartina	Unfertilized	.	2014-11-15 - 2015-05-27	2.122	1.453	71.001	1.461	1.000
Spartina	Unfertilized	.	2014-11-15 - 2015-11-12	0.961	1.453	71.001	0.661	1.000
Spartina	Unfertilized	.	2014-11-15 - 2016-06-17	4.369	1.453	71.001	3.007	0.255
Spartina	Unfertilized	.	2015-05-27 - 2015-11-12	-1.162	1.453	71.001	-0.800	1.000
Spartina	Unfertilized	.	2015-05-27 - 2016-06-17	2.246	1.453	71.001	1.546	1.000
Spartina	Unfertilized	.	2015-11-12 - 2016-06-17	3.408	1.453	71.001	2.346	1.000
.	.	2014-06-20	Not_planted,Fertilized - Spartina,Fertilized	-3.282	1.453	71.001	-2.259	1.000
.	.	2014-06-20	Not_planted,Fertilized - Not_planted,Unfertilized	-3.882	1.453	71.001	-2.672	0.654
.	.	2014-06-20	Not_planted,Fertilized - Spartina,Unfertilized	-3.301	1.453	71.001	-2.272	1.000
.	.	2014-06-20	Spartina,Fertilized - Not_planted,Unfertilized	-0.600	1.453	71.001	-0.413	1.000
.	.	2014-06-20	Spartina,Fertilized - Spartina,Unfertilized	-0.019	1.453	71.001	-0.013	1.000
.	.	2014-06-20	Not_planted,Unfertilized - Spartina,Unfertilized	0.581	1.453	71.001	0.400	1.000
.	.	2014-11-15	Not_planted Fertilized - Spartina Fertilized	1.104	1.453	71.001	0.760	1.000
.	.	2014-11-15	Not_planted Fertilized - Not_planted Unfertilized	-1.062	1.453	71.001	-0.731	1.000
.	.	2014-11-15	Not_planted Fertilized - Spartina Unfertilized	-0.920	1.453	71.001	-0.633	1.000
.	.	2014-11-15	Spartina Fertilized - Not_planted Unfertilized	-2.165	1.453	71.001	-1.491	1.000

(continued)

Plant	Fertilizer	SamplingDate	contrast	estimate	SE	df	t.ratio	p.value
.	.	2014-11-15	Spartina Fertilized - Spartina Unfertilized	-2.023	1.453	71.001	-1.393	1.000
.	.	2014-11-15	Not_planted Unfertilized - Spartina Unfertilized	0.142	1.453	71.001	0.098	1.000
.	.	2015-05-27	Not_planted Fertilized - Spartina Fertilized	5.912	1.453	71.001	4.070	0.008
.	.	2015-05-27	Not_planted Fertilized - Not_planted Unfertilized	7.156	1.546	71.431	4.630	0.001
.	.	2015-05-27	Not_planted Fertilized - Spartina Unfertilized	5.341	1.453	71.001	3.677	0.032
.	.	2015-05-27	Spartina Fertilized - Not_planted Unfertilized	1.244	1.546	71.431	0.805	1.000
.	.	2015-05-27	Spartina Fertilized - Spartina Unfertilized	-0.571	1.453	71.001	-0.393	1.000
.	.	2015-05-27	Not_planted Unfertilized - Spartina Unfertilized	-1.815	1.546	71.431	-1.174	1.000
.	.	2015-11-12	Not_planted Fertilized - Spartina Fertilized	0.294	1.453	71.001	0.203	1.000
.	.	2015-11-12	Not_planted Fertilized - Not_planted Unfertilized	-1.319	1.453	71.001	-0.908	1.000
.	.	2015-11-12	Not_planted Fertilized - Spartina Unfertilized	-0.457	1.453	71.001	-0.315	1.000
.	.	2015-11-12	Spartina Fertilized - Not_planted Unfertilized	-1.613	1.453	71.001	-1.111	1.000
.	.	2015-11-12	Spartina Fertilized - Spartina Unfertilized	-0.752	1.453	71.001	-0.517	1.000
.	.	2015-11-12	Not_planted Unfertilized - Spartina Unfertilized	0.862	1.453	71.001	0.593	1.000
.	.	2016-06-17	Not_planted Fertilized - Spartina Fertilized	2.806	1.635	71.895	1.716	1.000
.	.	2016-06-17	Not_planted Fertilized - Not_planted Unfertilized	-0.750	1.775	72.502	-0.423	1.000
.	.	2016-06-17	Not_planted Fertilized - Spartina Unfertilized	6.847	1.545	71.413	4.431	0.002
.	.	2016-06-17	Spartina Fertilized - Not_planted Unfertilized	-3.556	1.775	72.502	-2.003	1.000
.	.	2016-06-17	Spartina Fertilized - Spartina Unfertilized	4.042	1.545	71.413	2.615	0.761
.	.	2016-06-17	Not_planted Unfertilized - Spartina Unfertilized	7.597	1.689	71.917	4.498	0.002

Detail for Supplementary table 6

The table (Microsoft excel format) shows the differentially abundant taxa resulting from analysis by DESeq2 (Love et al., 2014) with means greater than 10 and absolute value $\log_2$ fold changes greater than 0.5. Log_2 fold changes (LFC) are ratios. The first treatment listed in contrast is the numerator and the second is the denominator. Therefore, positive values indicate the first treatment listed is positively increased over the second; conversely, negative LFC values indicate the second treatment listed in the contrast is increased over the first.

Additional information on SSU rRNA gene amplicon pre-processing

Raw reads were imported into QIIME2 (Boylen et al., 2019) version 2018.2 as type "EMPPairedEndSequences" and demultiplexed. Sequences were denoised using the "denoise-paired" command with the DADA2 (Callahan et al., 2016) plugin within QIIME2, trimmed at 30 bp on the left, and truncated to 250 bp for forward reads and 200 for reverse reads. The sequencing was done in several runs due to the multi-year nature of the study, so the resulting sets of sequences from all runs were combined after the denoising and trimming steps with the "p-overlap-method sum" option to merge the runs. Chimeras were removed with vsearch (Rognes et al., 2016).

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