Supplementary material

Influence of seagrass decline on the metabolic profile of sediment microbial communities

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Running title: Metabolic profile of seagrass sediment communities

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Supplementary tables

Supplementary Table S1 Sample ID, sampling date and site, and sediment depth and layer for each protein sample with successfully obtained MS/MS spectra.

Sample ID	Date	Site	Sediment Depth (cm)	Sediment Layer
MM_1			0 – 1	Тор
MM_2	12 July 2017	Nonvegetated	2 - 3	Upper Middle
MM_3	12 July 2017	Nonvegetateu	4 - 5	Lower Middle
MM_4			7 – 8	Bottom
MM_5			0 - 1	Тор
MM_6	12 July 2017	Vegetated	2 - 3	Upper Middle
MM_{2}	12 July 2017	vegetated	4 - 5	Lower Middle
MM_8			7 – 8	Bottom
MM_9			0 - 1	Top
MM_10	9 August 2017	Nonvegetated	2 - 3	Upper Middle
MM_11	9 August 2017	Nonvegetateu	4 - 5	Lower Middle
MM_12			7 - 8	Bottom
MM_13			0 – 1	Тор
MM_14	0. A	V	2 - 3	Upper Middle
MM_15	9 August 2017	Vegetated	4 - 5	Lower Middle
MM_16			7 - 8	Bottom
MM_17			0 – 1	Тор
MM_18	14 Camtaurh an 2017	Managaratatad	2 - 3	Upper Middle
MM_19	14 September 2017	Nonvegetated	4 - 5	Lower Middle
MM_20			7 - 8	Bottom
MM_21			0 – 1	Тор
MM_22	146 4 1 2017	X7	2 - 3	Upper Middle
MM_23	14 September 2017	Vegetated	4 - 5	Lower Middle
MM_24			7 - 8	Bottom
MM_25			0 – 1	Тор
MM_26	11.0 . 1 2017	NT 1	2 - 3	Upper Middle
MM_27	11 October 2017	Nonvegetated	3 - 4	Lower Middle
MM_28			7 - 8	Bottom
MM_29			0 – 1	Тор
MM_30	11 October 2017	Vacatatad	2 - 3	Upper Middle
MM_31	11 October 2017	Vegetated	3 - 4	Lower Middle
MM_32			7 - 8	Bottom
MM_33			0 – 1	Тор
MM_34	22 N	NI	2 - 3	Upper Middle
MM_35	22 November 2017	Nonvegetated	4 - 5	Lower Middle
MM_36			7 - 8	Bottom
MM_37			0 – 1	Тор
MM_38	22 No 1 2017	X 7 1	2 - 3	Upper Middle
MM_39	22 November 2017	Vegetated	4 - 5	Lower Middle
MM_40			7 – 8	Bottom
			· •	

Supplementary Table S1 Sample ID, sampling date and site, and sediment depth and layer for each protein sample with successfully obtained MS/MS spectra. (continued)

Sample ID	Date	Site	Sediment Depth (cm)	Sediment Layer
MM_41 MM_42 MM_43 MM_44	13 December 2017	Nonvegetated	0-1 $2-3$ $4-5$ $7-8$	Top Upper Middle Lower Middle Bottom
MM_45 MM_46 MM_47 MM_48	13 December 2017	Vegetated	0-1 $2-3$ $4-5$ $7-8$	Top Upper Middle Lower Middle Bottom
MM_49 MM_50 MM_51 MM_52	12 February 2018	Nonvegetated	0-1 2-3 4-5 7-8	Top Upper Middle Lower Middle Bottom
MM_53 MM_54 MM_55 MM_56	12 February 2018	Vegetated	0-1 $2-3$ $4-5$ $7-8$	Top Upper Middle Lower Middle Bottom
MM_58 MM_59 MM_60	26 March 2018	Nonvegetated	2 - 3 5 - 6 7 - 8	Upper Middle Lower Middle Bottom
MM_61 MM_62 MM_64	26 March 2018	Vegetated	0-1 2-3 7-8	Top Upper Middle Bottom
MM_65 MM_66 MM_67 MM_68	23 April 2018	Nonvegetated	0-1 $2-3$ $4-5$ $7-8$	Top Upper Middle Lower Middle Bottom
MM_69 MM_70 MM_71 MM_72	23 April 2018	Vegetated	0-1 2-3 4-5 7-8	Top Upper Middle Lower Middle Bottom
MM_73 MM_74 MM_75 MM_76	21 May 2018	Nonvegetated	0-1 $2-3$ $3-4$ $7-8$	Top Upper Middle Lower Middle Bottom
MM_77 MM_78 MM_79 MM_80	21 May 2018	Vegetated	0-1 $2-3$ $3-4$ $7-8$	Top Upper Middle Lower Middle Bottom
MM_81 MM_82 MM_83 MM_84	18 June 2018	Nonvegetated	0-1 $2-3$ $4-5$ $7-8$	Top Upper Middle Lower Middle Bottom

Supplementary Table S1 Sample ID, sampling date and site, and sediment depth and layer for each protein sample with successfully obtained MS/MS spectra. (continued)

MM_85 MM_86 MM_87 MM_88 18 June 2018 Vegetated 0 - 1 2 - 3 4 - 5 Bottom Top Upper Middle Lower Middle Moments MM_88 MM_90 MM_90 MM_90 MM_91 MM_92 9 July 2018 Puly 2018 Nonvegetated 0 - 1 2 - 3 4 - 5 Bottom Top Upper Middle Lower Middle Moments MM_93 MM_94 MM_95 MM_96 9 July 2018 Puly 2018 Vegetated 2 - 3 2 - 3 3 - 3 2 - 3 3 - 3 3 - 3 4 - 5 4 - 5	Sample ID	Date	Site	Sediment Depth (cm)	Sediment Layer
MM_87 MM_88 18 June 2018 Vegetated 4 – 5 7 – 8 Lower Middle Bottom MM_89 MM_90 MM_91 MM_91 9 July 2018 Nonvegetated 2 – 3 4 – 5 Upper Middle Lower Middle Bottom MM_93 MM_94 MM_95 9 July 2018 Vegetated 2 – 3 4 – 5 Upper Middle Lower Middle MM_95 MM_95 MM_96 9 July 2018 Vegetated 2 – 3 4 – 5 Upper Middle Lower Middle MM_98 MM_98 MM_99 8 August 2018 Nonvegetated 2 – 3 2 – 3 Upper Middle Mom_100 MM_100 MM_100 8 August 2018 Vegetated 2 – 3 4 – 5 Upper Middle Lower Middle Mom_104 MM_105 MM_106 MM_107 3 September 2018 Nonvegetated 2 – 3 4 – 5 Upper Middle Lower Middle Mom_110 MM_108 MM_110 3 September 2018 Nonvegetated 4 – 5 4 – 5 Lower Middle Bottom MM_109 MM_110 MM_111 4 October 2018 Nonvegetated 4 – 5 4 – 5 4 – 5 Lower Middle Bottom MM_117 MM_118 MM_119 4 October 2018 Nonvegetated 4 – 5 4 – 5 4 – 5 4 – 5 Lower Middle Lower Middle MM_117 MM_118 MM_119 4 October 2018 Nonvegetated 4 – 5 4 –	MM_85			0 – 1	Тор
MM_88 7-8 Bottom MM_89 0-1 Top MM_90 9 July 2018 Nonvegetated 4-5 Lower Middle MM_91 MM_92 4-5 Lower Middle MM_93 MM_94 4-5 Lower Middle MM_95 MM_94 4-5 Lower Middle MM_96 MM_96 4-5 Lower Middle MM_96 A-5 Lower Middle Bottom MM_97 MM_96 Nonvegetated 2-3 Upper Middle MM_98 August 2018 Nonvegetated 4-5 Lower Middle MM_100 8 August 2018 Vegetated 2-3 Upper Middle MM_101 8 August 2018 Vegetated 2-3 Upper Middle MM_103 8 August 2018 Vegetated 2-3 Upper Middle MM_105 MM_106 7-8 Bottom MM_106 3 September 2018 Nonvegetated 2-3 Upper Middle MM_110 3 September 2018 Vegetated 2-3	MM_86	19 Juna 2019	Vagatatad		Upper Middle
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MM_90 MM_91 MM_92 9 July 2018 Nonvegetated 2 - 3 4 - 5 7 - 8 Upper Middle Bottom MM_92 MM_94 MM_95 MM_96 9 July 2018 Vegetated 2 - 3 2 - 3 2 - 3 2 - 3 2 - 3 3 Upper Middle 4 - 5 4 - 5 4 - 5 2 - 3 3 Upper Middle Lower Middle MM_100 Upper Middle Lower Middle Lower Middle MM_100 MM_98 MM_99 MM_100 8 August 2018 Nonvegetated 2 - 3 4 - 5 2 - 3 3 Upper Middle Lower Middle MM_103 MM_104 Upper Middle Lower Middle MM_105 MM_106 MM_107 MM_106 MM_107 MM_108 3 September 2018 MM_108 Nonvegetated 2 - 3 4 - 5 2 - 3 3 Upper Middle Lower Middle MM_107 Upper Middle Lower Middle MM_108 Lower Middle Lower Middle MM_108 MM_109 MM_110 MM_1110 MM_1111 MM_112 Vegetated 2 - 3 4 - 5 4 - 5 4 - 5 Upper Middle Lower Middle Mom_116 MM_113 MM_114 MM_115 4 October 2018 MM_118 MM_117 Nonvegetated 4 - 5 4 - 5 4 - 5 4 - 5 Upper Middle Lower Middle Mom_119 MM_117 MM_118 MM_119 4 October 2018 MOctober 2018 Vegetated 2 - 3 4 - 5 4 - 5 4 - 5 4 - 5 4 - 5 4 - 5 Upper Middle Lower Middle Lower Middle Lower Middle	MM_88			7 - 8	Bottom
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MM_93	MM_91	9 July 2018	Nonvegetated	4 - 5	Lower Middle
MM_94 MM_95 MM_96 9 July 2018 Vegetated 2 - 3 4 - 5 7 - 8 Upper Middle Lower Middle Bottom MM_96 MM_96 8 August 2018 Nonvegetated 0 - 1 2 - 3 4 - 5 1 Cower Middle MM_100 Top Upper Middle Lower Middle M-101 MM_101 MM_102 MM_103 MM_104 8 August 2018 Vegetated 0 - 1 2 - 3 4 - 5 1 Cower Middle M-101 Top Upper Middle M-102 MM_108 MM_105 MM_106 MM_108 3 September 2018 Nonvegetated 0 - 1 4 - 5 2 - 3 4 - 5 1 Cower Middle M-111 Top Upper Middle M-112 MM_109 MM_110 MM_1110 MM_1111 3 September 2018 Vegetated 0 - 1 4 - 5 2 - 3 4 - 5 3 - 4 - 5 4 - 5	MM_92			7 - 8	Bottom
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MM_107 3 September 2018 Nonvegetated 4 - 5 Lower Middle Bottom MM_108 0 - 1 Top MM_109 0 - 1 Top MM_110 2 - 3 Upper Middle MM_111 4 - 5 Lower Middle MM_112 5 - 8 Bottom MM_113 0 - 1 Top MM_114 4 October 2018 Nonvegetated 2 - 3 Upper Middle MM_115 4 October 2018 Vegetated 0 - 1 Top MM_117 0 - 1 Top Upper Middle MM_118 4 October 2018 Vegetated 2 - 3 Upper Middle MM_119 4 October 2018 Vegetated 4 - 5 Lower Middle	MM_105			0 – 1	Тор
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MM_111 3 September 2018 Vegetated 4 - 5 Lower Middle MM_112 7 - 8 Bottom MM_113 0 - 1 Top MM_114 4 October 2018 Nonvegetated 2 - 3 Upper Middle MM_115 4 - 5 Lower Middle MM_116 7 - 8 Bottom MM_117 0 - 1 Top MM_118 4 October 2018 Vegetated 2 - 3 Upper Middle MM_119 4 October 2018 Vegetated 4 - 5 Lower Middle	MM_109			0 – 1	Тор
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MM_114 4 October 2018 Nonvegetated 2-3 Upper Middle Lower Middle Lower Middle Lower Middle Properties MM_116 7-8 Bottom MM_117 0-1 Top Upper Middle Properties MM_118 4 October 2018 Vegetated 2-3 Upper Middle Lower Middle Lower Middle	MM_113			0 – 1	Тор
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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	MM_115	4 October 2018	rionvegetated	4 - 5	Lower Middle
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$\begin{array}{cccccccccccccccccccccccccccccccccccc$	MM_117			0 – 1	Тор
MM_119 4-5 Lower Middle		4 Ootok 2019	Vocat-t-1	2 - 3	
MM_120	MM_119	4 October 2018	vegetated	4 - 5	Lower Middle
	MM_120			7 - 8	Bottom

Supplementary Table S2 Sample ID, sampling site, sediment layer and depth, sampling date, number of raw sequence pairs, number of assembled contigs by MEGAHIT, N50 and L50 assembly statistics, number of predicted CDSs by Prodigal, and number of eggNOG-mapper annotated CDSs.

Sample ID	Site	Layer (Depth)	Date	No. of Raw Sequence Pairs	No. of Contigs	N50*	L50 (bp)*	No. of Predicted CDSs	No. of Annotated CDSs
356 358	Vegetated	Top (0 - 1 cm) Lower Middle (4 - 5 cm)	8 August 2018	205,085,833 209,632,803	32,026,408 33,248,196	8,760,379 9,111,820	601 590	40,693,178 42,249,295	29,364,186 29,892,039
360 362	Nonvegetated	Top (0 - 1 cm) Lower Middle (4 - 5 cm)	8 August 2018	213,766,540 216,556,629	21,634,340 27,534,653	6,073,512 8,174,204	595 592	27,526,969 34,788,216	19,599,377 24,307,842

^{*} The notation was preserved from the original output of BBTools statswrapper.sh.

Supplementary Table S3 The proportion of each COG functional category (NAAF) and the number of proteins assigned to each category. The proportion and the number of proteins assigned to category C (energy production and conversion) are highlighted.

COG Category	NAAF (%)	Number of Proteins
C – Energy production and conversion	15.18	8,224
S – Function unknown	12.62	6,299
G – Carbohydrate transport and metabolism	11.45	6,823
E – Amino acid transport and metabolism	9.25	6,893
M – Cell wall/membrane/envelope biogenesis	8.89	2,999
P – Inorganic ion transport and metabolism	8.43	4,441
Multiple functional categories	7.65	2,603
O – Posttranslational modification, protein turnover, chaperones	7.02	2,901
J – Translation, ribosomal structure and biogenesis	5.28	1,507
H – Coenzyme transport and metabolism	2.29	1,494
Q – Secondary metabolites biosynthesis, transport and catabolism	2.26	1,356
F – Nucleotide transport and metabolism	1.78	1,475
I – Lipid transport and metabolism	1.72	1,421
N – Cell motility	1.38	599
K – Transcription	1.35	1,169
U – Intracellular trafficking, secretion, and vesicular transport	1.27	731
L – Replication, recombination and repair	0.98	397
T – Signal transduction mechanisms	0.79	574
V – Defense mechanisms	0.23	217
D – Cell cycle control, cell division, chromosome partitioning	0.18	147
Total	100.00	52,270

Supplementary Table S4 Overview of selected enzymes, their enzymatic products, and corresponding KO entries used to evaluate mediation processes of various fermentation products.

Name	Product	KO Entry
		K00169
		K00170
Pyruvate:ferredoxin oxidoreductase	Acetyl-CoA, carbon dioxide	K00171
		K00172
		K03737
Pyruvate formate-lyase	Acetyl-CoA, formate	K00656
Acetyl-CoA hydrolase	Acetate	K01067
Acetate kinase	Acetate	K00925
Acetoacetate decarboxylase	Acetone, carbon dioxide	K01574
		K00001
		K04022
		K13951
		K13952
Alcohol dahudraganaga	Ethanol	K13954
Alcohol dehydrogenase	Ethanoi	K13980
		K18857
		K00002
		K13979
		K00114
		K00122
		K00123
		K00124
		K00126
Formate dehydrogenase	Carbon dioxide	K00127
Formate denydrogenase	Carbon dioxide	K22515
		K05299
		K15022
		K00125
		K22516
Lactate dehydrogenase	Lactate	K00016
Acetolactate decarboxylase	Acetoin, carbon dioxide	K01575
Methylmalonyl-CoA decarboxylase	Propionyl-CoA, carbon dioxide	K11264
welly illialony i-CoA decal boxy lase	1 Topionyi-CoA, carbon dioxide	K01604
Lastoyl Co A dahydratasa	Acrylayl Co A	K20626
Lactoyl-CoA dehydratase	Acryloyl-CoA	K20627
Propionaldehyde dehydrogenase	Propionyl-CoA	K13922
Butyrate kinase	Butyrate	K00929
Butyryl-CoA:acetate CoA transferase	Butyrate, acetyl-CoA	K01034
Daijiji Cori.accaac Cori transferasc	Dailylate, accept Cort	K01035

 $\textbf{Supplementary Table S5} \ \ \textbf{Overview of KEGG modules used for assessing various types of microbial metabolism}.$

Type of Metabolism	KEGG Module
	M00567
Mathanaganasis	M00357
Methanogenesis	M00356
	M00563
Methane oxidation	M00174
Nitrogen fixation	M00175
Assimilatory nitrate reduction	M00531
Dissimilatory nitrate reduction	M00530
Denitrification	M00529
Nitrification	M00528
Complete nitrification, comammox	M00804
Anammox	M00973
Assimilatory sulphate reduction	M00176
Dissimilatory sulphate reduction	M00596
Thiosulfate oxidation by SOX complex	M00595

Supplementary Table S6 Enzymes involved in dissimilatory sulphate reduction and their KO entries.

Name	KO Entry
Sulphate adenylyltransferase	K00958
Adenylylsulphate reductase	K00394 K00395
Dissimilatory sulphite reductase	K11180 K11181 K27196