Table 1 Environmental characteristic of the samples

Type	Redox (mv)	Ammonium (µmol/Kg dry sed.)	Nitrite (µmol/Kg dry sed.)	Nitrate (µmol/Kg dry sed.)	NH_4^+/NO_x^-	Salinity (‰)	pH	Temp. (°C)	%Water content (w/w)
Wall	213.7	30.91	0.74	23.6	1.30	23.0	6.11	20.25	57.08
Surface	228.5	112.7	2.60	23.26	3.67	22.5	6.47	20.1	57.61
Black	-108.6	39.04	1.08	1.82	11.79	29.5	6.44	19.9	58.04
Yellow	80.5	18.17	1.04	7.79	1.49	27.0	5.98	19.85	57.96

Table 2 Alpha diversity of AOA, AOB, anammox and n-damo bacteria in sediment samples

Sample	Related clones / Coverage (%)				OTU**				Shannon-Wiener				Chao1			
	1*	2	3	4	1	2	3	4	1	2	3	4	1	*2*	3	4
Wall	47/90.4	31/77.5	44/88.0	42/93.3	8	17	12	3	1.7835	2.5921	2.0389	0.5010	9.0	24.5	17.0	3.0
Surface	45/86.5	44/84.6	46/92.0	35/77.8	6	20	17	4	1.4207	2.7535	2.2912	0.9790	6.0	29.0	50.0	4.5
Black	26/74.3	41/78.8	42/84.0	18/40.0	4	17	13	3	0.9693	2.3909	2.0078	0.5566	4.0	35.3	16.8	3.5
Yellow	33/94.3	48/92.3	50/66.7	15/33.3	5	5	5	3	1.2504	1.3410	0.6510	0.2449	5.0	5.0	5.0	2.0
Overall	151/86.8	164/83.7	182/80.9	110/61.1	11	43	28	10	1.7849	3.1528	2.3912	1.8043	14.0	53.9	39.0	10.3

*1-AOA; 2-AOB; 3-Anammox bacteria; 4-n-damo bacteria;

**Based on percentage sequence identity of 97% similarity for 16S rRNA gene and 95% for *pmoA* and *amoA* genes

Figure Captions

Fig. 1 The sampling map of this study at Mai Po Nature Reserve of Hong Kong (a) and a schematic of sample types (b). Sampling areas are cycled in red. This map was drawn based on Bing Map (Microsoft Co., www.bing.com/maps/).

Fig. 2 Consensus phylogenetic trees constructed after subjecting amplified translated archaeal (a) and bacterial (b) *amoA* amino acid, anammox bacterial 16S rRNA (c) and deduced n-damo *pmoA* amino acid (d) sequences to neighbor joining analyses. OTUs were defined with the variances of 3% (16S rRNA gene) or 5% (*amoA* and *pmoA* genes) difference by MOTHUR. Trees were reconstructed using alignments of 197 AOA amino acid positions, 167 AOB amino acid positions, 252 anammox nucleotide positions and 123 n-damo amino acid positions, respectively. The OTUs from the four sampling types in this study are highlighted using symbols according to the figure legend, and the representative clones of the relevant OTU are detailed in Fig. S6. The following numbers in parenthesis refer to how many detected sequences fell in the branch or subcluster. Numbers at the nodes represent the levels of bootstrap support based on 1000 re-sampled data sets (only >50% values are shown).

Fig. 3 Three dimensional discrete plots of PCoA based on the Fast UniFrac metric of n-damo bacteria diversity using *pmoA* gene sequences. The responses of different n-damo communities toward the first three principal components are shown in both unweighted qualitative measurement (a) and quantitative analysis (b) using normalized abundance weights.

Fig. 4 Abundance of archaeal and bacterial *amoA* gene copy numbers, anammox and n-damo

bacterial 16S rRNA gene copy numbers from the bioturbated areas in Mai Po mangrove sediments. Mean values and standard deviations were calculated according to the triplicate assay within a single qPCR setup.

Fig. 5 Redundancy analyses (RDA) for the physicochemical parameters (red solid arrow), targeting microbial groups (blue dot arrow) and the samples (black hollow circle) using archaeal (a) and bacterial (b) *amoA*, anammox 16S rRNA (c) and n-damo *pmoA* (d) gene sequences amplified in the present work.

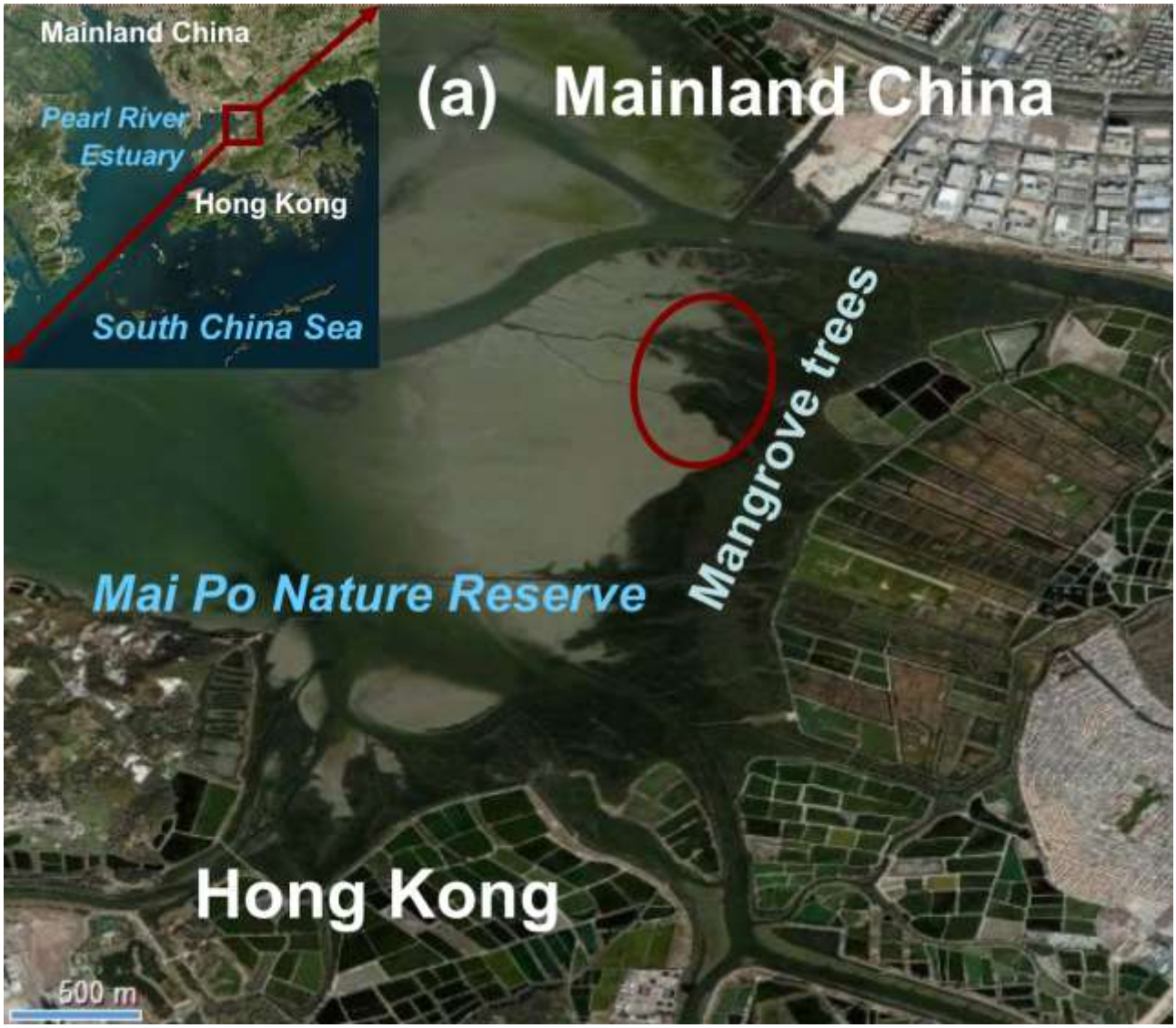
Mainland China
Pearl River
Estuary
Hong Kong
South China Sea
(a) Mainland China
Mangrove trees
Mai Po Nature Reserve
Hong Kong
500 m

Fig.1-a

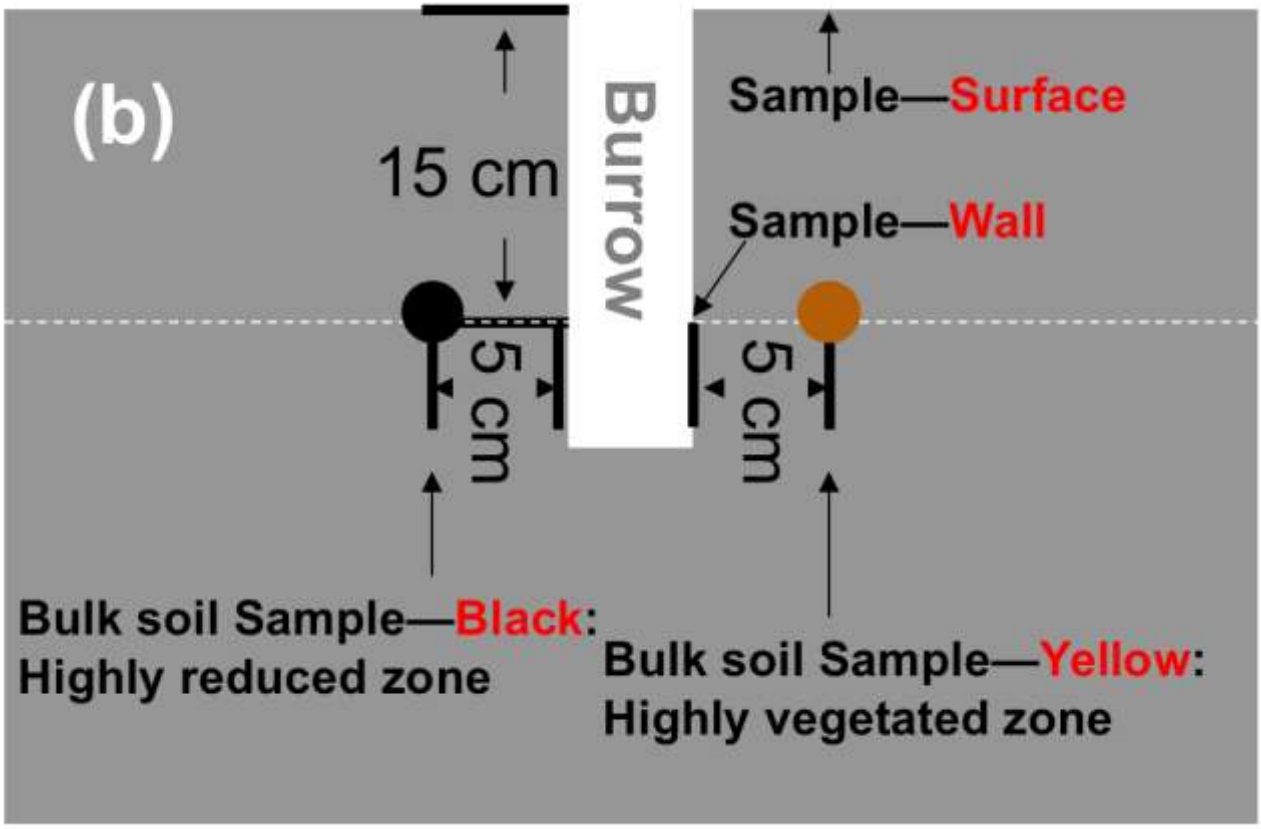
(b)
15 cm
Burrow
Sample—Surface
Sample—Wall
5 cm
5 cm
Bulk soil Sample—Black:
Highly reduced zone
Bulk soil Sample—Yellow:
Highly vegetated zone

Fig. 1-b

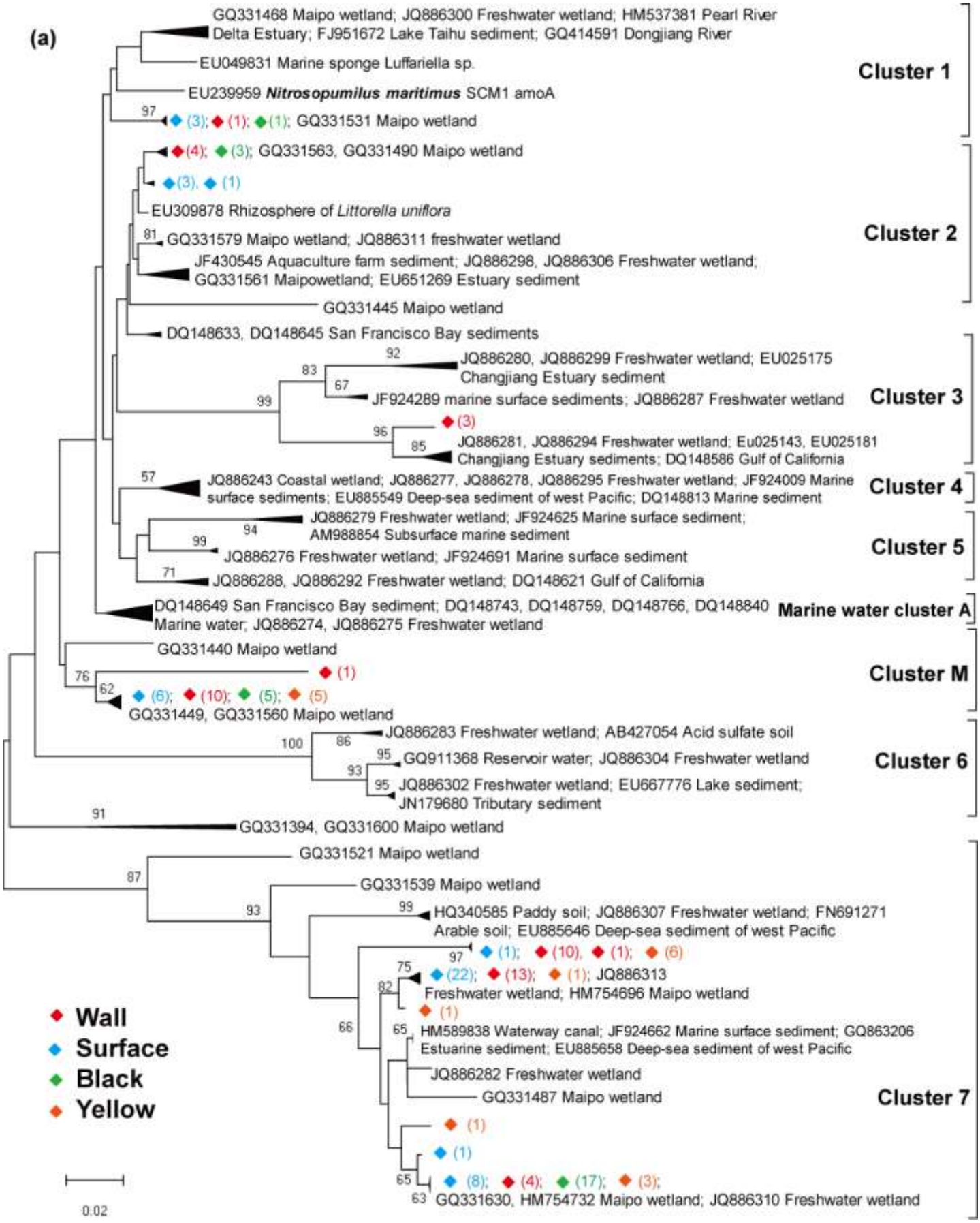
(a)
GQ331468 Maipo wetland; JQ886300 Freshwater wetland; HM537381 Pearl River Delta Estuary; FJ951672 Lake Taihu sediment; GQ414591 Dongjiang River
EU049831 Marine sponge Luffariella sp.
EU239959 Nitrosopumilus maritimus SCM1 amoA
97
(3); (1); (1); GQ331531 Maipo wetland
Cluster 1
(4); (3); GQ331563, GQ331490 Maipo wetland
(3), (1)
EU309878 Rhizosphere of Littorella uniflora
81
GQ331579 Maipo wetland; JQ886311 freshwater wetland
JF430545 Aquaculture farm sediment; JQ886298, JQ886306 Freshwater wetland; GQ331561 Maipowetland; EU651269 Estuary sediment
GQ331445 Maipo wetland
Cluster 2
DQ148633, DQ148645 San Francisco Bay sediments
92
JQ886280, JQ886299 Freshwater wetland; EU025175 Changjiang Estuary sediment
83
67
JF924289 marine surface sediments; JQ886287 Freshwater wetland
99
(3)
96
85
JQ886281, JQ886294 Freshwater wetland; Eu025143, EU025181 Changjiang Estuary sediments; DQ148586 Gulf of California
Cluster 3
57
JQ886243 Coastal wetland; JQ886277, JQ886278, JQ886295 Freshwater wetland; JF924009 Marine surface sediments; EU885549 Deep-sea sediment of west Pacific; DQ148813 Marine sediment
Cluster 4
94
JQ886279 Freshwater wetland; JF924625 Marine surface sediment; AM988854 Subsurface marine sediment
99
JQ886276 Freshwater wetland; JF924691 Marine surface sediment
71
JQ886288, JQ886292 Freshwater wetland; DQ148621 Gulf of California
Cluster 5
DQ148649 San Francisco Bay sediment; DQ148743, DQ148759, DQ148766, DQ148840 Marine water; JQ886274, JQ886275 Freshwater wetland
Marine water cluster A
GQ331440 Maipo wetland
(1)
76
62
(6); (10); (5); (5)
GQ331449, GQ331560 Maipo wetland
Cluster M
JQ886283 Freshwater wetland; AB427054 Acid sulfate soil
100
86
95
GQ911368 Reservoir water; JQ886304 Freshwater wetland
93
95
JQ886302 Freshwater wetland; EU667776 Lake sediment; JN179680 Tributary sediment
Cluster 6
91
GQ331394, GQ331600 Maipo wetland
GQ331521 Maipo wetland
87
GQ331539 Maipo wetland
93
99
HQ340585 Paddy soil; JQ886307 Freshwater wetland; FN691271 Arable soil; EU885646 Deep-sea sediment of west Pacific
97
(1); (10), (1); (6)
75
(22); (13); (1); JQ886313 Freshwater wetland; HM754696 Maipo wetland
82
(1)
66
65
HM589838 Waterway canal; JF924662 Marine surface sediment; GQ863206 Estuarine sediment; EU885658 Deep-sea sediment of west Pacific
JQ886282 Freshwater wetland
GQ331487 Maipo wetland
(1)
(1)
65
(8); (4); (17); (3);
63
GQ331630, HM754732 Maipo wetland; JQ886310 Freshwater wetland
Cluster 7
Wall
Surface
Black
Yellow
0.02

Fig. 2-a

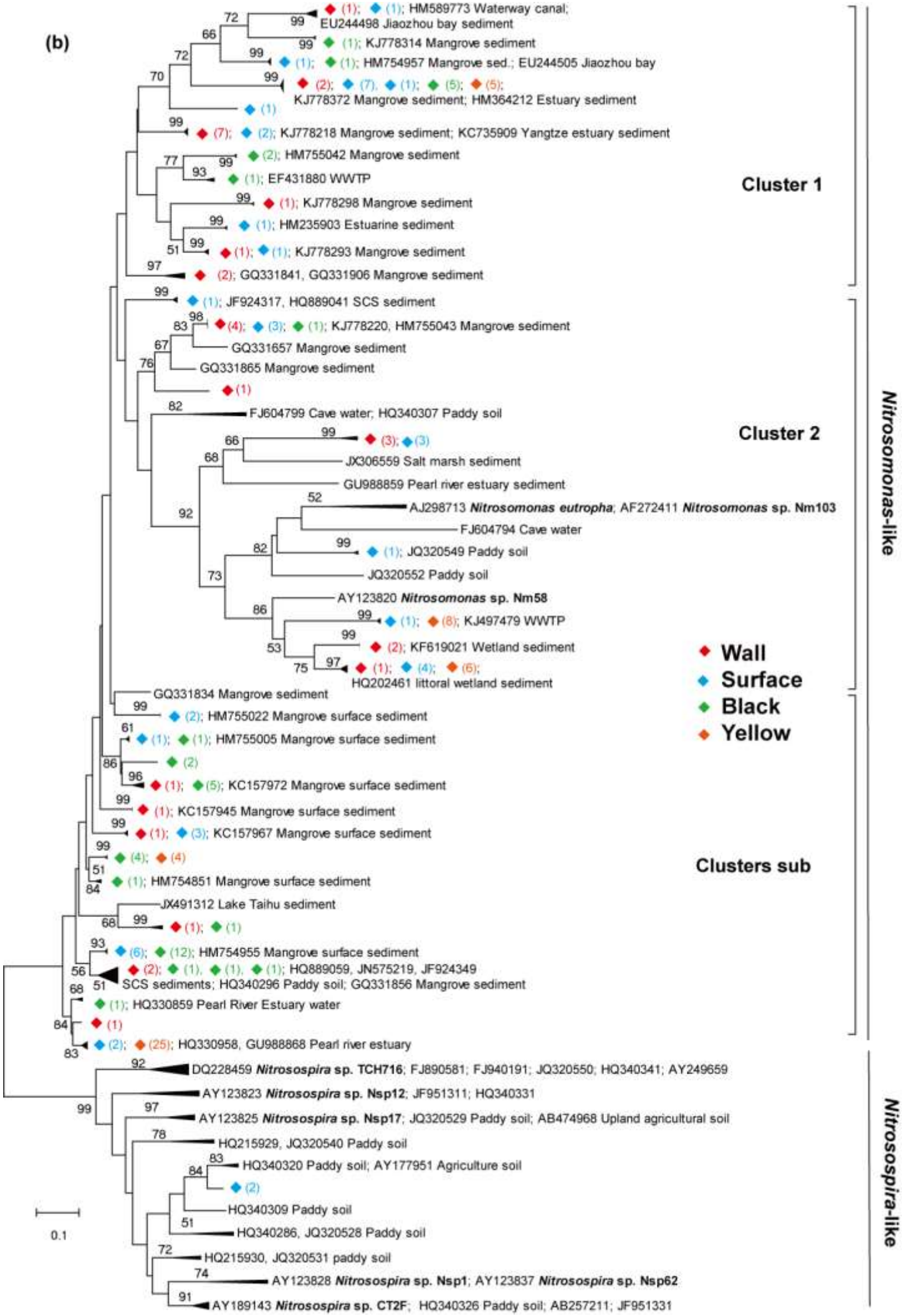
(b)
◆ (1); ◆ (1); HM589773 Waterway canal; EU244498 Jiaozhou bay sediment
◆ (1); KJ778314 Mangrove sediment
◆ (1); ◆ (1); HM754957 Mangrove sed.; EU244505 Jiaozhou bay
◆ (2); ◆ (7); ◆ (1); ◆ (5); ◆ (5); KJ778372 Mangrove sediment; HM364212 Estuary sediment
◆ (1)
◆ (7); ◆ (2); KJ778218 Mangrove sediment; KC735909 Yangtze estuary sediment
◆ (2); HM755042 Mangrove sediment
◆ (1); EF431880 WWTP
◆ (1); KJ778298 Mangrove sediment
◆ (1); HM235903 Estuarine sediment
◆ (1); ◆ (1); KJ778293 Mangrove sediment
◆ (2); GQ331841, GQ331906 Mangrove sediment
Cluster 1
◆ (1); JF924317, HQ889041 SCS sediment
◆ (4); ◆ (3); ◆ (1); KJ778220, HM755043 Mangrove sediment
GQ331657 Mangrove sediment
GQ331865 Mangrove sediment
◆ (1)
FJ604799 Cave water; HQ340307 Paddy soil
◆ (3); ◆ (3)
JX306559 Salt marsh sediment
GU988859 Pearl river estuary sediment
AJ298713 Nitrosomonas eutropha; AF272411 Nitrosomonas sp. Nm103
FJ604794 Cave water
◆ (1); JQ320549 Paddy soil
JQ320552 Paddy soil
AY123820 Nitrosomonas sp. Nm58
◆ (1); ◆ (8); KJ497479 WWTP
◆ (2); KF619021 Wetland sediment
◆ (1); ◆ (4); ◆ (6); HQ202461 littoral wetland sediment
Cluster 2
GQ331834 Mangrove sediment
◆ (2); HM755022 Mangrove surface sediment
◆ (1); ◆ (1); HM755005 Mangrove surface sediment
◆ (2)
◆ (1); ◆ (5); KC157972 Mangrove surface sediment
◆ (1); KC157945 Mangrove surface sediment
◆ (1); ◆ (3); KC157967 Mangrove surface sediment
◆ (4); ◆ (4)
◆ (1); HM754851 Mangrove surface sediment
JX491312 Lake Taihu sediment
◆ (1); ◆ (1)
◆ (6); ◆ (12); HM754955 Mangrove surface sediment
◆ (2); ◆ (1); ◆ (1); ◆ (1); HQ889059, JN575219, JF924349 SCS sediments; HQ340296 Paddy soil; GQ331856 Mangrove sediment
◆ (1); HQ330859 Pearl River Estuary water
◆ (1)
◆ (2); ◆ (25); HQ330958, GU988868 Pearl river estuary
Clusters sub
Wall
Surface
Black
Yellow
Nitrosomonas-like
DQ228459 Nitrosospira sp. TCH716; FJ890581; FJ940191; JQ320550; HQ340341; AY249659
AY123823 Nitrosospira sp. Nsp12; JF951311; HQ340331
AY123825 Nitrosospira sp. Nsp17; JQ320529 Paddy soil; AB474968 Upland agricultural soil
HQ215929, JQ320540 Paddy soil
HQ340320 Paddy soil; AY177951 Agriculture soil
◆ (2)
HQ340309 Paddy soil
HQ340286, JQ320528 Paddy soil
HQ215930, JQ320531 paddy soil
AY123828 Nitrosospira sp. Nsp1; AY123837 Nitrosospira sp. Nsp62
AY189143 Nitrosospira sp. CT2F; HQ340326 Paddy soil; AB257211; JF951331
Nitrosospira-like
0.1

Fig. 2-b

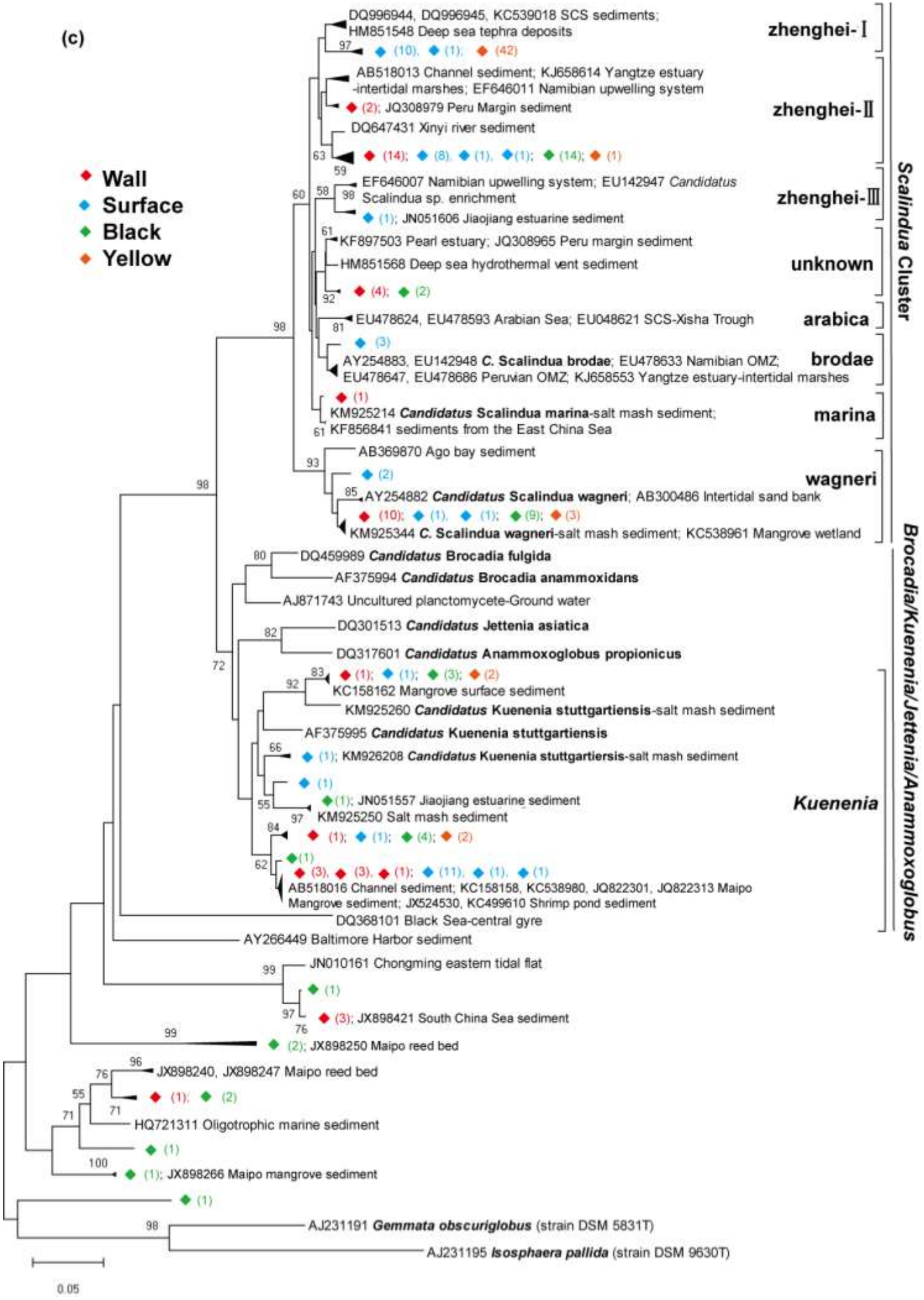
(c)
Wall
Surface
Black
Yellow
DQ996944, DQ996945, KC539018 SCS sediments; HM851548 Deep sea tephra deposits
(10); (1); (42)
zhenghei-Ⅰ
AB518013 Channel sediment; KJ658614 Yangtze estuary -intertidal marshes; EF646011 Namibian upwelling system
(2); JQ308979 Peru Margin sediment
DQ647431 Xinyi river sediment
(14); (8); (1); (1); (14); (1)
zhenghei-Ⅱ
EF646007 Namibian upwelling system; EU142947 Candidatus Scalindua sp. enrichment
(1); JN051606 Jiaojiang estuarine sediment
zhenghei-Ⅲ
KF897503 Pearl estuary; JQ308965 Peru margin sediment
HM851568 Deep sea hydrothermal vent sediment
(4); (2)
unknown
EU478624, EU478593 Arabian Sea; EU048621 SCS-Xisha Trough
arabica
(3)
AY254883, EU142948 C. Scalindua brodae; EU478633 Namibian OMZ; EU478647, EU478686 Peruvian OMZ; KJ658553 Yangtze estuary-intertidal marshes
brodae
(1)
KM925214 Candidatus Scalindua marina-salt mash sediment; KF856841 sediments from the East China Sea
marina
AB369870 Ago bay sediment
(2)
AY254882 Candidatus Scalindua wagneri; AB300486 Intertidal sand bank
(10); (1); (1); (9); (3)
KM925344 C. Scalindua wagneri-salt mash sediment; KC538961 Mangrove wetland
wagneri
Scalindua Cluster
DQ459989 Candidatus Brocadia fulgida
AF375994 Candidatus Brocadia anammoxidans
AJ871743 Uncultured planctomycete-Ground water
DQ301513 Candidatus Jettenia asiatica
DQ317601 Candidatus Anammoxoglobus propionicus
(1); (1); (3); (2)
KC158162 Mangrove surface sediment
KM925260 Candidatus Kuenenia stuttgartiensis-salt mash sediment
AF375995 Candidatus Kuenenia stuttgartiensis
(1); KM926208 Candidatus Kuenenia stuttgartiersis-salt mash sediment
(1)
(1); JN051557 Jiaojiang estuarine sediment
KM925250 Salt mash sediment
(1); (1); (4); (2)
(1)
(3), (3), (1); (11), (1), (1)
AB518016 Channel sediment; KC158158, KC538980, JQ822301, JQ822313 Maipo Mangrove sediment; JX524530, KC499610 Shrimp pond sediment
Kuenenia
DQ368101 Black Sea-central gyre
AY266449 Baltimore Harbor sediment
JN010161 Chongming eastern tidal flat
(1)
(3); JX898421 South China Sea sediment
(2); JX898250 Maipo reed bed
JX898240, JX898247 Maipo reed bed
(1); (2)
HQ721311 Oligotrophic marine sediment
(1)
(1); JX898266 Maipo mangrove sediment
(1)
AJ231191 Gemmata obscuriglobus (strain DSM 5831T)
AJ231195 Isosphaera pallida (strain DSM 9630T)
0.05
Brocadia/Kuenenia/Jettenia/Anammoxoglobus

Fig. 2-c

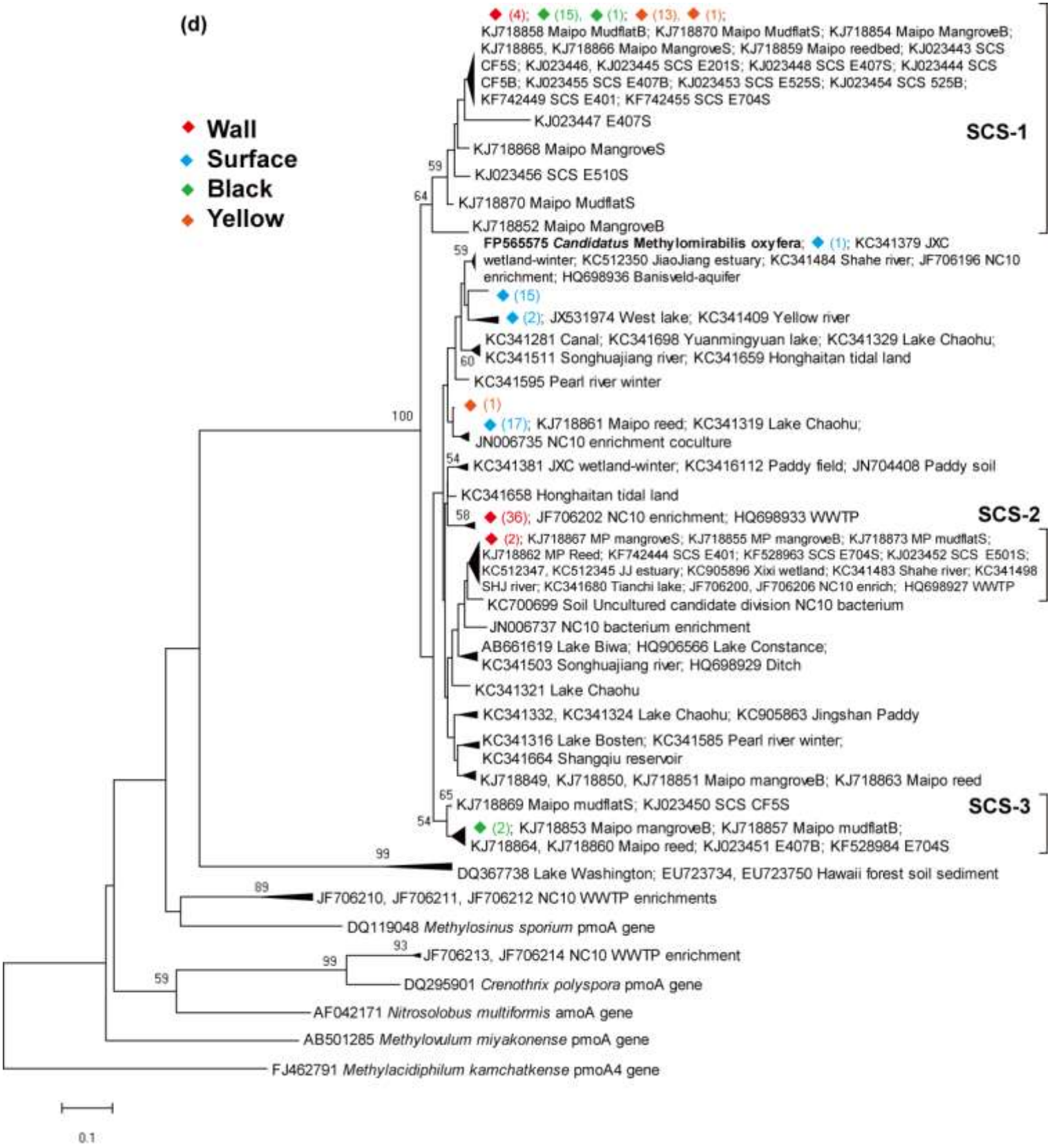
(d)
Wall
Surface
Black
Yellow
(4); (15), (1); (13), (1);
KJ718858 Maipo MudflatB; KJ718870 Maipo MudflatS; KJ718854 Maipo MangroveB; KJ718865, KJ718866 Maipo MangroveS; KJ718859 Maipo reedbed; KJ023443 SCS CF5S; KJ023446, KJ023445 SCS E201S; KJ023448 SCS E407S; KJ023444 SCS CF5B; KJ023455 SCS E407B; KJ023453 SCS E525S; KJ023454 SCS 525B; KF742449 SCS E401; KF742455 SCS E704S
KJ023447 E407S
KJ718868 Maipo MangroveS
KJ023456 SCS E510S
KJ718870 Maipo MudflatS
KJ718852 Maipo MangroveB
SCS-1
FP565575 Candidatus Methylomirabilis oxyfera; (1); KC341379 JXC wetland-winter; KC512350 JiaoJiang estuary; KC341484 Shahe river; JF706196 NC10 enrichment; HQ698936 Banisveld-aquifer
(15)
(2); JX531974 West lake; KC341409 Yellow river
KC341281 Canal; KC341698 Yuanmingyuan lake; KC341329 Lake Chaohu; KC341511 Songhuajiang river; KC341659 Honghaitan tidal land
KC341595 Pearl river winter
(1)
(17); KJ718861 Maipo reed; KC341319 Lake Chaohu; JN006735 NC10 enrichment coculture
KC341381 JXC wetland-winter; KC3416112 Paddy field; JN704408 Paddy soil
KC341658 Honghaitan tidal land
(36); JF706202 NC10 enrichment; HQ698933 WWTP
SCS-2
(2); KJ718867 MP mangroveS; KJ718855 MP mangroveB; KJ718873 MP mudflatS; KJ718862 MP Reed; KF742444 SCS E401; KF528963 SCS E704S; KJ023452 SCS E501S; KC512347, KC512345 JJ estuary; KC905896 Xixi wetland; KC341483 Shahe river; KC341498 SHJ river; KC341680 Tianchi lake; JF706200, JF706206 NC10 enrich; HQ698927 WWTP
KC700699 Soil Uncultured candidate division NC10 bacterium
JN006737 NC10 bacterium enrichment
AB661619 Lake Biwa; HQ906566 Lake Constance; KC341503 Songhuajiang river; HQ698929 Ditch
KC341321 Lake Chaohu
KC341332, KC341324 Lake Chaohu; KC905863 Jingshan Paddy
KC341316 Lake Bosten; KC341585 Pearl river winter; KC341664 Shangqiu reservoir
KJ718849, KJ718850, KJ718851 Maipo mangroveB; KJ718863 Maipo reed
KJ718869 Maipo mudflatS; KJ023450 SCS CF5S
SCS-3
(2); KJ718853 Maipo mangroveB; KJ718857 Maipo mudflatB; KJ718864, KJ718860 Maipo reed; KJ023451 E407B; KF528984 E704S
DQ367738 Lake Washington; EU723734, EU723750 Hawaii forest soil sediment
JF706210, JF706211, JF706212 NC10 WWTP enrichments
DQ119048 Methylosinus sporium pmoA gene
JF706213, JF706214 NC10 WWTP enrichment
DQ295901 Crenothrix polyspora pmoA gene
AF042171 Nitrosolobus multiformis amoA gene
AB501285 Methyloulum miyakonense pmoA gene
FJ462791 Methylacidiphilum kamchatkense pmoA4 gene
0.1

Fig. 2-d

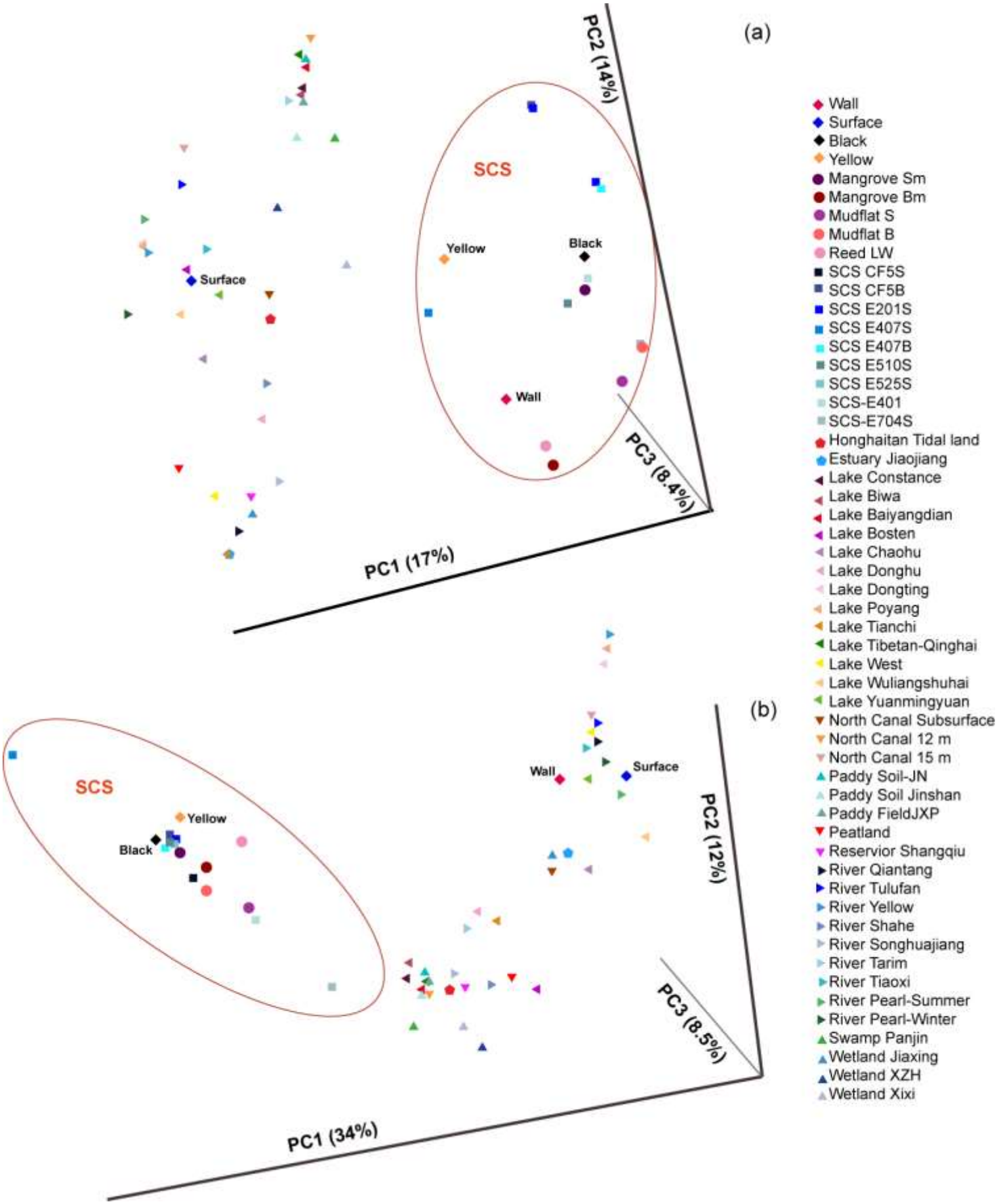
(a)
PC2 (14%)
PC3 (8.4%)
PC1 (17%)
SCS
Yellow
Black
Surface
Wall
(b)
PC2 (12%)
PC3 (8.5%)
PC1 (34%)
SCS
Yellow
Black
Wall
Surface
Wall
Surface
Black
Yellow
Mangrove Sm
Mangrove Bm
Mudflat S
Mudflat B
Reed LW
SCS CF5S
SCS CF5B
SCS E201S
SCS E407S
SCS E407B
SCS E510S
SCS E525S
SCS-E401
SCS-E704S
Honghaitan Tidal land
Estuary Jiaojiang
Lake Constance
Lake Biwa
Lake Baiyangdian
Lake Bosten
Lake Chaohu
Lake Donghu
Lake Dongting
Lake Poyang
Lake Tianchi
Lake Tibetan-Qinghai
Lake West
Lake Wuliangshuhai
Lake Yuanmingyuan
North Canal Subsurface
North Canal 12 m
North Canal 15 m
Paddy Soil-JN
Paddy Soil Jinshan
Paddy FieldJXP
Peatland
Reservior Shangqiu
River Qiantang
River Tulufan
River Yellow
River Shahe
River Songhuajiang
River Tarim
River Tiaoxi
River Pearl-Summer
River Pearl-Winter
Swamp Panjin
Wetland Jiaxing
Wetland XZH
Wetland Xixi

Fig. 3

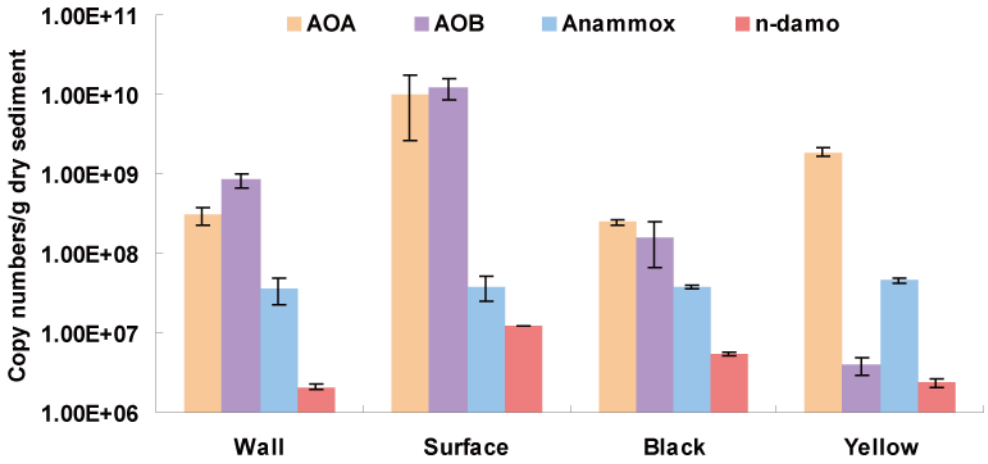
AOA
AOB
Anammox
n-damo
Copy numbers/g dry sediment
1.00E+11
1.00E+10
1.00E+09
1.00E+08
1.00E+07
1.00E+06
Wall
Surface
Black
Yellow

Fig. 4

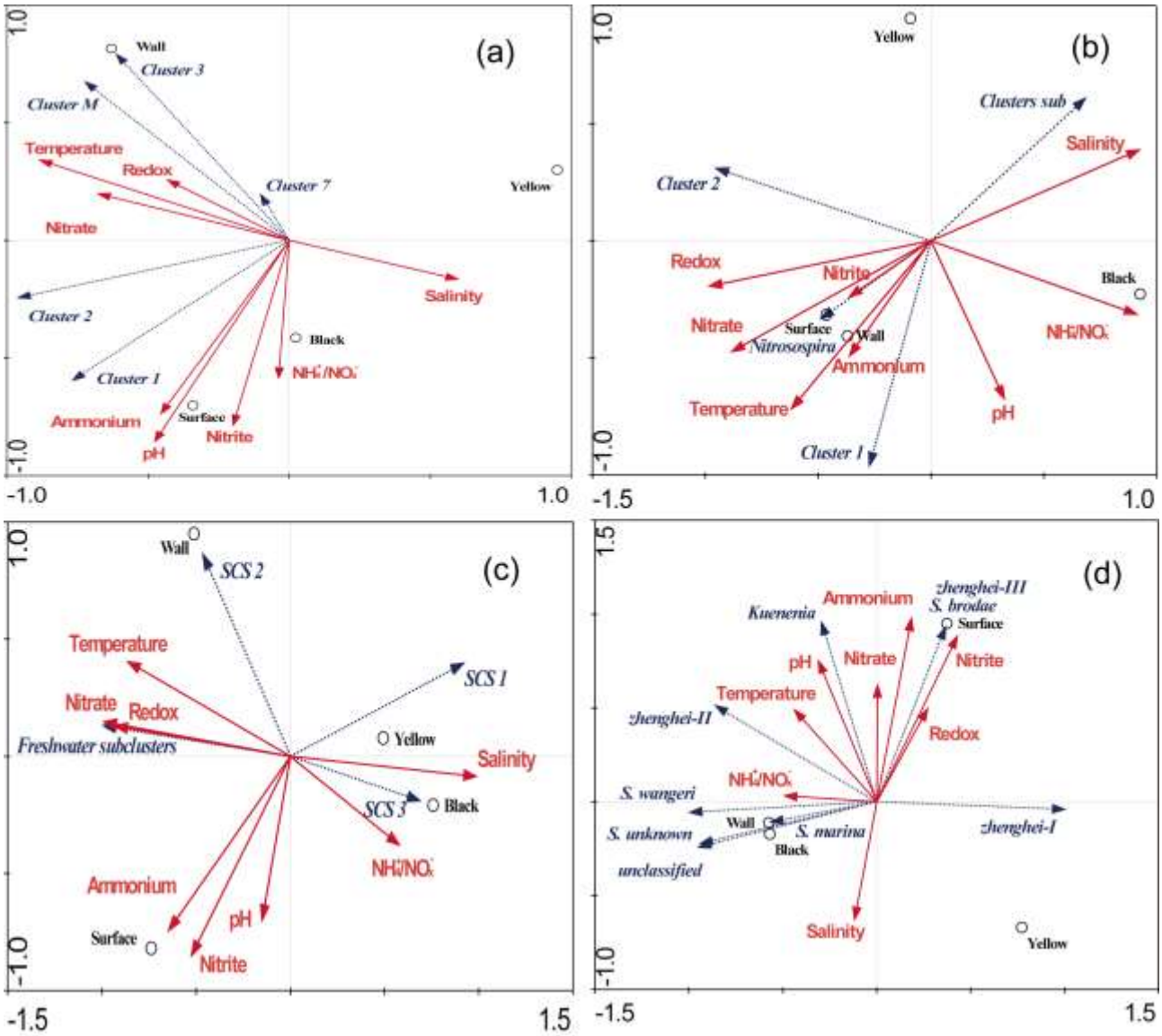
(a)
Wall
Cluster 3
Cluster M
Temperature
Redox
Cluster 7
Yellow
Nitrate
Salinity
Cluster 2
Black
Cluster 1
NH4+/NO3-
Surface
Ammonium
Nitrite
pH
1.0
-1.0
(b)
Yellow
Clusters sub
Salinity
Cluster 2
Redox
Nitrite
Black
Nitrate
Surface
Wall
NH4+/NO3-
Nitrosospira
Ammonium
Temperature
pH
Cluster 1
-1.5
(c)
Wall
SCS 2
Temperature
SCS 1
Nitrate
Redox
Freshwater subclusters
Yellow
Salinity
SCS 3
Black
NH4+/NO3-
Ammonium
pH
Surface
Nitrite
1.5
(d)
Ammonium
Zhenghei-III
Kuenenia
S. brodae
Surface
pH
Nitrate
Nitrite
Temperature
Zhenghei-II
Redox
NH4+/NO3-
S. wangeri
Zhenghei-I
Wall
S. unknown
S. marina
Black
unclassified
Salinity
Yellow

Fig. 5