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Supplement of

Carbon sources of benthic fauna in temperate lakes across multiple trophic states

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Supplementary Information

Table S1: qPCR primers and standards and their corresponding references

Target	*Primer*	*Sequence 5' - 3'*	*Reference*	*Standard*
Archaeal *16S rRNA*	*Arc915F_mod*	AAT TGG CGG GGG AGC AC	Cadillo-Quiroz et al. (2006)	*Thermoplasma acidophilum*
	Arc1059R	GCC ATG CAC CWC CTC T	Yu et al. (2005)	
Bacterial *16S rRNA*	*Bac908F_mod*	AAC TCA AAK GAA TTG ACG GG	Lever et al. (2015)	*Desolfotignum phosphitoxidans*
	Bac1075R	CAC GAG CTG ACG ACA RCC	Ohkuma and Kudo (1998)	
pmoA	*A189F*	GGN GAC TGG GAC TTC TGG	Holmes et al. (1995)	*Methylococcus capsulatus*
	Mb661R	CCG GMG CAA CGT CYT TAC C	Costello and Lidstrom (1999)	
mcrA	*Mlas_F*	GGT GGT GTM GGD TTC ACM CAR TA	Steinberg and Regan (2009)	*Methanocorpusculum parvum*
	mcrA-rev	CGT TCA TBG CGT AGT TVG GRT AGT	Steinberg and Regan (2009)	

Table S2: qPCR protocols for each primer pair.

Primer target:		**Arc**	**Bac**	**pmoA**	**mcrA**
qPCR step	**time (min:s)**	**primer-specific temperature** (°C)			
1. Initial Activation	05:00	Always 95			
2. Denaturation	00:10	Always 95			
3. Annealing	*00:30*	*55*	*60*	*(62) 52*	*56*
4. Polymerization	00:15	Always 72			
5. Acquisition	*00:05*	*81*	*82*	*80*	*80*
Cycle repeats step 2.-5.		***40***	***45***	***(10+) 35***	***40***
6. Denaturation	01:15	*Always 95*			
7. Acquisition	*continuous*	*55-95*	*60-95*	*60-95*	*53-95*
8. Cooling	∞	Always 4			

Table S3: Overview of chemicals used in the different master mix for PCR for one reaction (25 µl total reaction volume) (A). Temperate and time protocols used for each PCR during library preparation. Underlined are the steps which are repeated (cycle number), see main text for details (B).

(A)

	Boost PCR	**Tail PCR**	**Index PCR**
Go Taq G2 DNA Polymerase (5 µl/ml)	0.125 µl	0.125 µl	0.125 µl
Go Taq Colorless reaction buffer (5x)	5 µl	5 µl	5 µl
PCR nucleotide mix (10 mM)	0.5 µl	0.5 µl	0.5 µl
primer 1	0.75 µl	0.75 µl (0.1875 of each: nex0-nex3)	2.5 µl
primer 2	0.75 µl	0.75 µl (0.1875 of each: nex0-nex3)	2.5 µl
BSA	1.25 µl	none	none
H_2O (mol. grade)	14.625 µl	16.875 µl	12.375 µl
Template	2 µl	1 µl	2 µl

(B)

	Temperature (°C) / Time (min:s)		
PCR	**Boost**	**Tail**	**Index**
Activation	95 / 05:00	95 / 02:00	95 / 02:00
Denaturation	98 / 00:20	95 / 00:20	95 / 00:20
Annealing	49 / 00:30	49 / 00:30	55 / 00:40
Polymerization	72 / 00:30	72 / 00:30	72 / 00:30
Denaturation	72 / 05:00	72 / 05:00	72 / 05:00
Cooling	4 / ∞	4 / ∞	4 / ∞

Table S4: ^{13}C-C of specific sediment layers and phytoplankton samples from this study (A) and literature (B). For plankton samples, 'surface' indicates surface water samples that were obtained using plankton tows with different mesh sizes. Asterisks indicate samples that were not decarbonized.

(A)

Lake	Station	Type	depth	size or feature	δ^{13}C
Lucerne	shore	phytoplankton	surface	> 50 µm	-26.3*
Lucerne	shore	phytoplankton	surface	> 100 µm	-29.4*
Lucerne	shore	phytoplankton	surface	> 20 µm	-30.1
Lucerne	shore	phytoplankton	surface	> 20 µm	-19.5*
Lucerne	shore	phytoplankton	surface	> 20 µm	-31.2
Lucerne	shore	phytoplankton	surface	> 20 µm	-26.7*
Lucerne	shore	phytoplankton	surface	20-100 µm	-29.5*
Lucerne	shore	phytoplankton	surface	> 50 µm	-30.3
Lucerne	shore	phytoplankton	surface	> 50 µm	-21.1*
Baldegg	1	sediment	21 cm	layer	-35.4
Zurich	1	sediment	2-2.5 cm	algal bloom	-33.7
Greifen	1	sediment	13	layer	-34.1
Zurich	3	sediment	18.5 cm	sediment with plant material	-29.1
Zurich	3	sediment	18.5 cm	plant material (leaves, wood)	-29.2
Greifen	3	sediment	14-15 cm	layer	-35.7
Baldegg	1	sediment	21 cm	brighter layer	-35.6

(B)

Target	δ^{13}C range (‰)	Environment	Reference
Phytoplankton	-34.4 to -5.9	*sub-arctic lakes*	*Vuorio et al. (2006)*
Phytoplankton	-36.6 to -28.7	*Lake Memphremagog, Quebec*	*Lazerte (1983)*
Algae	-35 to -15	*small water bodies Australia*	*Boon and Bunn (1994)*
Floating plants	-32 to -25		
Emergent macrophytes	-31 to -25		
Submerged macrophytes	-33 to - 15		
Epiphytes	-32 to - 20		
Freshwater seston	-35.2 to -23.9	*Sacramento–San Joaquin River Delta*	*Cloern et al. (2002)*
sediment trap OM	-40 to -22	*Lake Lugano*	*Bernasconi et al. (1997)*
sediment trap POC	-39 to -27	*Lake Greifen (yearly cycle)*	*Hollander et al. (1993)*
POC	-60 to -20	*Lake Lugano (yearly cycle)*	*Lehmann et al. (2004)*

Table S5: Abundance of Oligochaetes and Chironomid Larvae per m² for each Lake station, indicated are averages of the three stations and the corresponding standard deviations (SD), please note for Lake Zurich averages and SD were calculated from station 2 and 3 only (*).

Lake	Oligochaetes (m^{-2})	Chironomid Larvae (m^{-2})
Lucerne		
Station 1	170	1019
Station 2	57	340
Station 3	0	566
Average (±SD)	*75 (±86)*	*641 (±346)*
Zurich		
Station 1	0	0
Station 2	906	962
Station 3	1302	736
*Average (±SD)**	*1104 (±280)*	*849 (±160)*
Zug		
Station 1	1132	57
Station 2	1245	0
Station 3	1641	57
Average (±SD)	*1340 (±267)*	*38 (±33)*
Greifen		
Station 1	3339	0
Station 2	962	0
Station 3	3736	0
Average (±SD)	*2679 (±1500)*	-
Baldegg		
Station 1	9282	57
Station 2	4868	0
Station 3	396	170
Average (±SD)	*4849 (±4443)*	*75 (±86)*

Table S6: (A): food sources and feeding modes as well as distributions of oligochaete worms, and (B): of chironomid larvae, where feeding modes are after Moog (2002).

(A)

Taxa	Food source and feeding mode	Distribution	Reference
Embolocephalus velutinus	*Naididae*: look for food at surface of sediment or other surfaces, most surface deposit feeders	oligo- und mesotrophic lakes, cold stenothermic species	Van Haaren and Soors (2013); (Martin et al. (2008); Brinkhurst (1982) Brinkhurst and Chua (1969)
Limnodrilus hoffmeisteri	all *Tubificidae* are thought to be subsurface deposit feeders that take in sediment: and mainly feed on bacteria (and algae) as main food source	in eu- to hypereutrophic lakes, very tolerant to oxygen deficiencies, omnipresent, wide ecological valence	
Limnodrilus profundicola			
Potamothrix hammoniensis		Mostly in bigger lakes, correlates with organic part in sediment originating from algae, omnipresent species with wide ecological valence	
Potamothrix veydovskyi		indicative for mid to high pollution, eutrophic conditions	
Tubifex tubifex		Widespread. Often dominant under eutrophic or highly oligotrophic conditions.	

(B)

Taxa	Food sources and feeding mode	Distribution	Reference
Sergentia coracina	mainly detritus feeder (gathering collector), also filter feeding of sedimented fine particulate OM. Stretch out of tubes and feed from surrounding mud, mud dwellers.	mesotrophic systems	Pillot (2009)
Paracladopelma laminatum	mainly predators	Less Fe(II) tolerant < 0.2 mg Fe(II) /L, eutrophic lakes, rarely in oligotrophic lakes, tolerant of organic loading	Pillot (2009)
Procladius sp.	mainly predators, also detritus feeding of algae (gathering collector), prey are small crustaceans and later in life cycle *chironomidae* and oligochaetes.	in mineral and organic sediment, stagnant and slow flow water types, warm water chironomid, lower critical O_2 concentration	Vallenduuk and Pillot (2007) Brodersen et al. (2004)
Tanytarsus norvegicus	mainly detritus feeders (gathering collector), also grazing (scrapers, raspers) and filter feeding of sedimented fine particulate OM, build tubes		
Macropelopia fehlmanni	mainly predacious, also detritus feeding, prey are mainly *chironomidae, plecoptera, copeopoda*, detritus		Vallenduuk and Pillot (2007)
Chironomus riparius/piger gr.	mainly filter feeder, also shredders and grazers, of suspended FPOM, CPOM, fallen leaves, plant tissue, terrestrial and algal OM (Goedkoop et al. 2006), but believed to switch from mainly surface deposit-feeding to microbial gardening under hypoxic conditions (Stief et al. 2005)	4-7 generations a year, emerging from march to november, one generation 34.8 days at 15 °C, prefer organic muddy substrate with characteristic for polluted flowing water, heavy load of OM, warm water chironomid, lower critical O_2 concentrations	Pillot (2009) Stief et al. (2005) Goedkoop et al. (2006) Brodersen et al. (2004)
Ablabesmyia monilis	mainly predators, also detritus feeding, actively attacking *chironomidae*, oligochaetes and partially *cladocera* but also dead prey (diatoms, detritus)	warm water chironomid, lower critical O_2 concentrations	Vallenduuk and Pillot (2007) Chaloner and Wotton (1996) Brodersen et al. (2004) Saether (1980)
Tanytarsus sp.	mainly detritus feeding, but also grazing and filter feeding of sedimented fine particulate OM, build tubes	oligo to mesotrophic lakes (Saether, 1980)	
Micropsectra sp.	mainly detritus feeding, but also grazing and filter feeding of sedimented fine particulate OM	cold water chironomid	
Stempellina bausei	grazing and detritus feeding, of epilithic algal tissue, biofilm, partially POM (endo and epilithic algal tissue, partially living plant tissue)		
Orthocladiinae gen. sp.	mainly algae		Stevenson et al. (1996)
Polypedilum nubeculosum	mainly detritus feeding, but also grazing and filter feeding of sedimented fine particulate OM, Bacteria seem to be most important food (Moore, 1979)	2-3 generations adults emerge from the end of April to early October when temp in spring reaches 8°C, bottom dwellers, make long tubes, density correlated with oxygen contents, organic sediment	Pillot (2009) Moore (1979)
Chironomus sp.	mainly filter feeding, also shredders and grazers of suspended FPOM, CPOM, prey, build tubes		
Chironomus commutatus	mainly filter feeding, also shredders and grazers of suspended FPOM, CPOM, prey, build tubes	More common in stagnant water, can stand low O_2 conditions	Pillot (2009)

Table S7: Depth distribution of oligochaete (A) and chironomid (B) species in each lake

A: Oligochaetes

Lake Baldegg	**# of individuals per species**					**Total # of individuals**
Depth (cm)	**Tubificidae (+bristles)**	**Tubificidae (-bristles)**	**Tubifex Tubifex**	**Limnodrilus hoffmeisteri**	**Limnodrilus profundicula**	
0-1		2		1		**3**
1-2		5				**5**
2-3						
3-4						
4-6	1	9		11	10	**31**
6-8	2	19	1	26	4	**52**
8-10						
10-12		15		11		**26**

Lake Greifen	**# of individuals per species**					**Total # of individuals**
Depth (cm)	**Tubificidae (+bristles)**	**Tubificidae (-bristles)**	**Tubifex Tubifex**	**Limnodrilus hoffmeisteri**	**Potamothrix hammoniensis**	
0-1						
1-2	6					**6**
2-3	10	1			4	**15**
3-4	5					**5**
4-6	8		1		4	**13**
6-8	10		2	1		**13**
8-10	3		2			**5**
10-12						

Lake Zug	**# of individuals per species**					**Total # of individuals**
Depth (cm)	**Tubificidae (+bristles)**	**Tubificidae (-bristles)**	**Tubifex Tubifex**	**Limnodrilus hoffmeisteri**	**Potamothrix hammoniensis**	
0-1						
1-2	4					**4**
2-3		3				**3**
3-4						
4-6	2	2	2	1	3	**10**
6-8						
8-10						
10-12	3	1	1			**5**
12-14	3		2			**5**
14-16						
16-18	2					**2**

Lake Zurich	# of individuals per species					Total # of individuals
Depth (cm)	**Tubificidae (+bristles)**	**Tubificidae (-bristles)**	**Embolocephalus velutinus**	**Limnodrilus hoffmeisteri**	**Potamothrix hammoniensis**	
0-1						
1-2						
2-3	1					**1**
3-4	5				1	**6**
4-6	1		1	1	2	**5**
6-8	3	1			1	**5**
8-10						
10-12		1				**1**

Lake Lucerne	# of individuals per species	Total # of individuals
Depth (cm)	**Potamothrix vejdoyski**	
0-1		
1-2		
2-3	1	**1**
3-4		
4-6		
6-8		
8-10		
10-12		

B: Larvae

Lake Baldegg	# of individuals per species			Total # of individuals
Depth (cm)	**Micropsectra sp.**	**Chironomus riparius/piger gr.**	**Orthocladiinae gen. Sp.**	
0-1				
1-2	1			**1**
2-3				
3-4		1		**1**
4-6				
6-8				
8-10				
10-12				
12-14				
14-16				
16-18			1	**1**

Lake Zug	# of individuals per species		Total # of individuals
Depth (cm)	**Sergentia coracina**	**Procladius sp.**	
0-1			
1-2	1		**1**
2-3			
3-4		1	**1**

Lake Zurich	**# of individuals per species ***									**Total # of individuals**
Depth (cm)	**S. coracina**	**P. sp.**	**T. norvegicus**	**C. riparius /piger gr.**	**T. sp.**	**M. sp.**	**P. nubeculosum**	**C. sp.**	**C. commutatus**	
0-1	1					2				**3**
1-2					1	2				**3**
2-3	1		1	2		2	1			**7**
3-4										
4-6	1			1						**2**
6-8	1	1		2						**4**
8-10									2	**2**
10-12						1		1		**2**
12-14								1		**1**
14-16					2					**2**
16-18					1					**1**
18-20										
20-24					1	1				**2**

Lake Lucerne	**# of individuals per species ***										**Total # of individuals**
Depth (cm)	**S. coracina**	**P. laminatum**	**T. norvegicus**	**C. riparius /piger gr.**	**T. sp.**	**M. sp.**	**A. monilis**	**P. sp.**	**M. fehlmanni**	**S. bausei**	
0-1	1				3		1				**5**
1-2	1	1	2			5		3	2		**14**
2-3	1							1			**2**
3-4								2	1	1	**4**
4-6								5			**5**
6-8				1							**1**

**S. coracina = Sergentia coracina, P .laminatum= Paracladopelma laminatum, T. novergicus = Tanytarsus norvegicus, T. sp. = Tanytarsus sp., M. sp. = Micropsectra sp., A. monilis = Ablabesmyia monilis, P. sp. = Procladius sp., M, fehlmanni = Macropelopia fehlmanni, S. bausei = Stempellina bausei, C. xxxxx = Chironomus xxxxx, P. nubeculosum = Polypedilum nubeculosum.*

Table S8: Overview of ZOTUs that were enriched (>5% of total reads) or highly enriched (>50% of total reads) in whole macrofaunal specimen (w), macrofaunal guts (g), or macrofaunal bodies after gut removal (b). Oligochaetes are shown in (A), chironomid larvae in (B). Classifications were done to the genus- or family-level via phylogenetic trees with manually optimized alignments in the ARB software (Ludwig et al. (2004), Supplementary Fig. S8). Fractions indicate the number of w, b, or g analyzed per lake in which a ZOTU was enriched (second column from right) or highly enriched (right column). LB = Lake Baldegg, LG = Lake Greifen, LZug = Lake Zug, LZ = Lake Zurich, LL = Lake Lucerne.

(A)

ZOTU#	**Classification**	**# of fauna, where ZOTU enriched, broken down according to w, b, and g (range of % fraction of total reads)**	**# of total fauna where ZOTU highly enriched**
Fusobacteria			
ZOTU389	*Fusobacterium* Cl. I	LB: 1/11 w (7%)	LB: 5/14; LG: 5/5; LZug: 4/9; LL: 1/1
ZOTU1	*Fusobacterium* Cl. I	LB: 4/11 w (44-79%), 1/3 b (87%), 1/3 g (91%); LG: 4/5 w (64-77%); LZug: 4/7 w (75-97%)	
ZOTU7, 22	*Fusobacterium* Cl. I	LG: 1/1 b (62%), 1/1 g (86%)	
ZOTU5, 13	*Fusobacterium* Cl. I	LB: 4/11 w (5-24%); LG: 1/5 w (65%)	
Proteobacteria			
β-Proteobacteria			
ZOTU6	Uncl. Subcl. (*Rhodocyclales*)	LZ: 1/1 w (59%)	LZ: 1/1
ZOTU8	*Deefgea* (*Neisseriales*)	LB: 1/3 g (93%)	LB: 1/14
ε-Proteobacteria			
ZOTU18	*Wolinella* (*Campylobacterales*)	LZug: 1/7 w (55%)	LZug: 2/9
ZOTU9	Uncl. Cl.	LG: 1/5 w (31%); LZug: 1/2 b (5-69%)	
α-Proteobacteria			
ZOTU4	*Holosporaceae* (*Holosporales*)	LB: 1/11 w (93%); LZug: 2/7 w (7-60%)	LB: 1/14; LZug: 1/9
Bacteroidetes			
ZOTU10	*Flavobacterium* (*Flavobacteriales*)	LB: 4/11 w (6-10%), 1/3 g (6%); LG: 3/5 w (10-17%); LZug: 1/7 w (8%)	-
Parcubacteria			
ZOTU199	Uncl. Cl. I	LB: 2/11 w (7%); 1/3 b, 60%; 1/3 g, 5%)	LB: 1/14
TOTAL			**LB: 8/14; LG: 5/5; LZug: 7/9; LZ: 1/1; LL: 1/1**

(B)

ZOTU#	***Classification***	***# of fauna, where ZOTU enriched, broken down according to w, b, and g (range of % fraction of total reads)***	***# of total fauna where ZOTU highly enriched***
Fusobacteria			
ZOTU1	*Fusobacterium* Cl. I	*LZ (1/1 b) (8%)*	*LZ (3/7 >5%; 1/7 >50%)*
ZOTU5, 13	*Fusobacterium* Cl. I	*LZ (2/6 w) (6-57%)*	
Proteobacteria			
γ-Proteobacteria			
ZOTU11	*Serratia (Enteromonadales)*	*LL (1/6 b) (83%)*	*LL (5/10 >5%; 4/10 >50%)*
ZOTU21, 3	*Aeromonas (Aeromonadales)*	*LL (1/4 w, 79%; 2/6 b, 11-78%; 2/6 g, 98-99%)*	
ZOTU26	Uncl. Cl. *(Pseudomonadales)*	*LL (1/4 w) (40%)*	
β-Proteobacteria			
ZOTU6	Uncl. Subcl. *(Rhodocyclales)*	*LL (1/4 w) (56%)*	*LL (3/10 >5%; 2/10 >50%)*
ZOTU12	Uncl. Subcl. *(Burkholderiales)*	*LL (2/6 b) (22-56%)*	
α-Proteobacteria			
ZOTU2	*Wolbachia (Rickettsiales)*	*LZ (2/6 w), LL (1/4 w, 3/6 b) (42-71%)*	*LZ (2/7 >5%; 2/7 >50%); LL (5/10 >5%; 4/10 >50%)*
Bacteroidetes			
ZOTU28	Uncl. Wastewater & Gut Group *(Bacteroidales)*	*LZ (1/6 w) (72%)*	*LZ (1/7 >50%)*
Firmicutes			
ZOTU19	"Insect Gut Cl." *(Clostridiales)*	*LL (1/4 w, 2/6 g) (19-31%)*	*LL (3/10 >5%; 0/10 >50%)*
TOTAL			**LB: 0/2; LZ: 3/7; LL: 9/10**

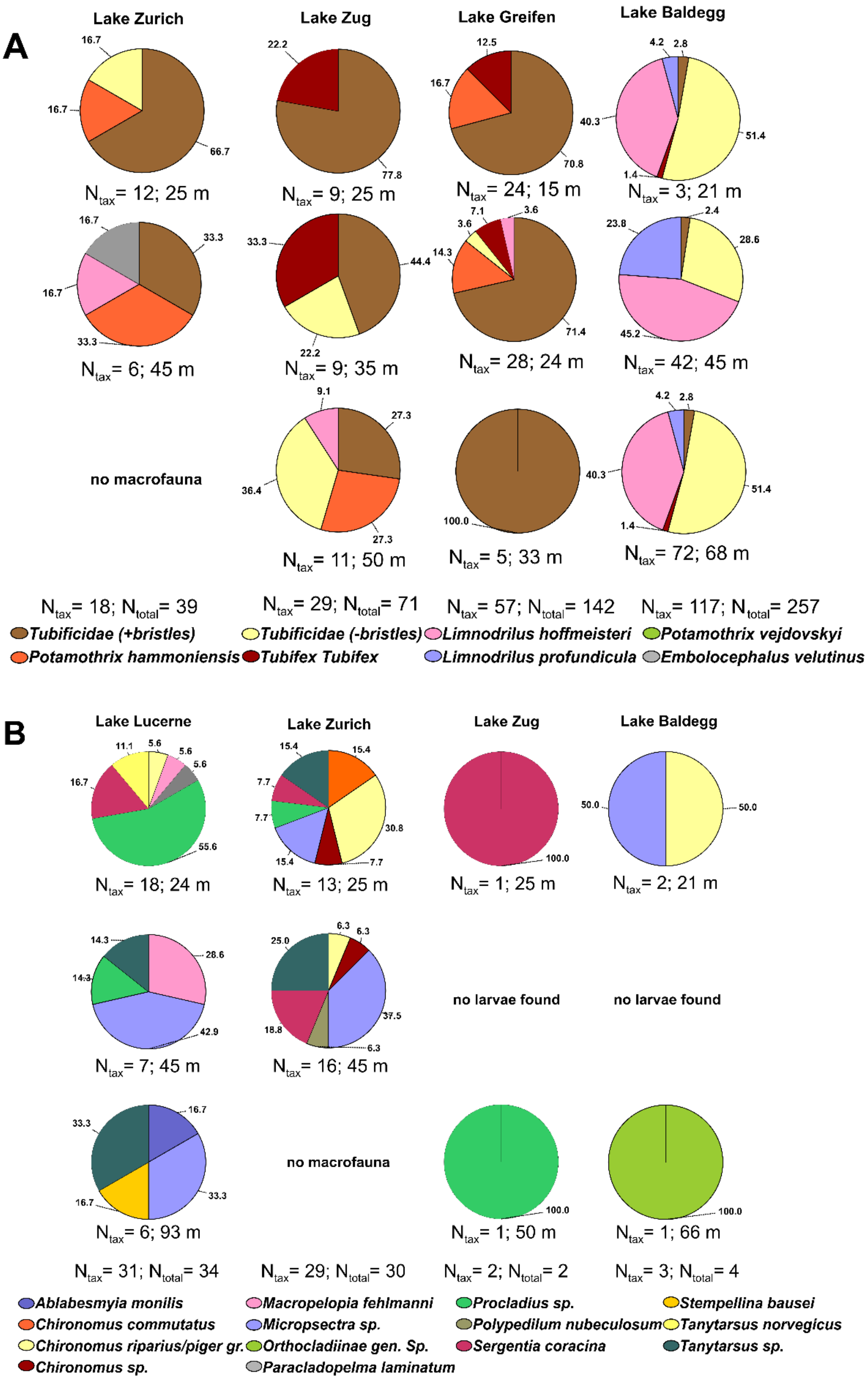


Figure S1: Taxonomy results for selected individuals of the two main classes found (A: oligochaete worms, Ntax=222, Ntot = 513; B: chironomid larvae, Ntax=65, Ntot=70) for each lake and station individually. Numbers indicate the % abundance of taxonomically analyzed individuals. No chironomid larvae were found in Lake Greifen and at station 2 of Lake Baldegg (45 m) and Lake Zug (35 m). In Lake Lucerne only 4 oligochaetic worms were found of which 1 was taxonomically analyzed (Potamothrix vejdoyski).No Macrofauna was found at the deep station of Lake Zurich (137 m).

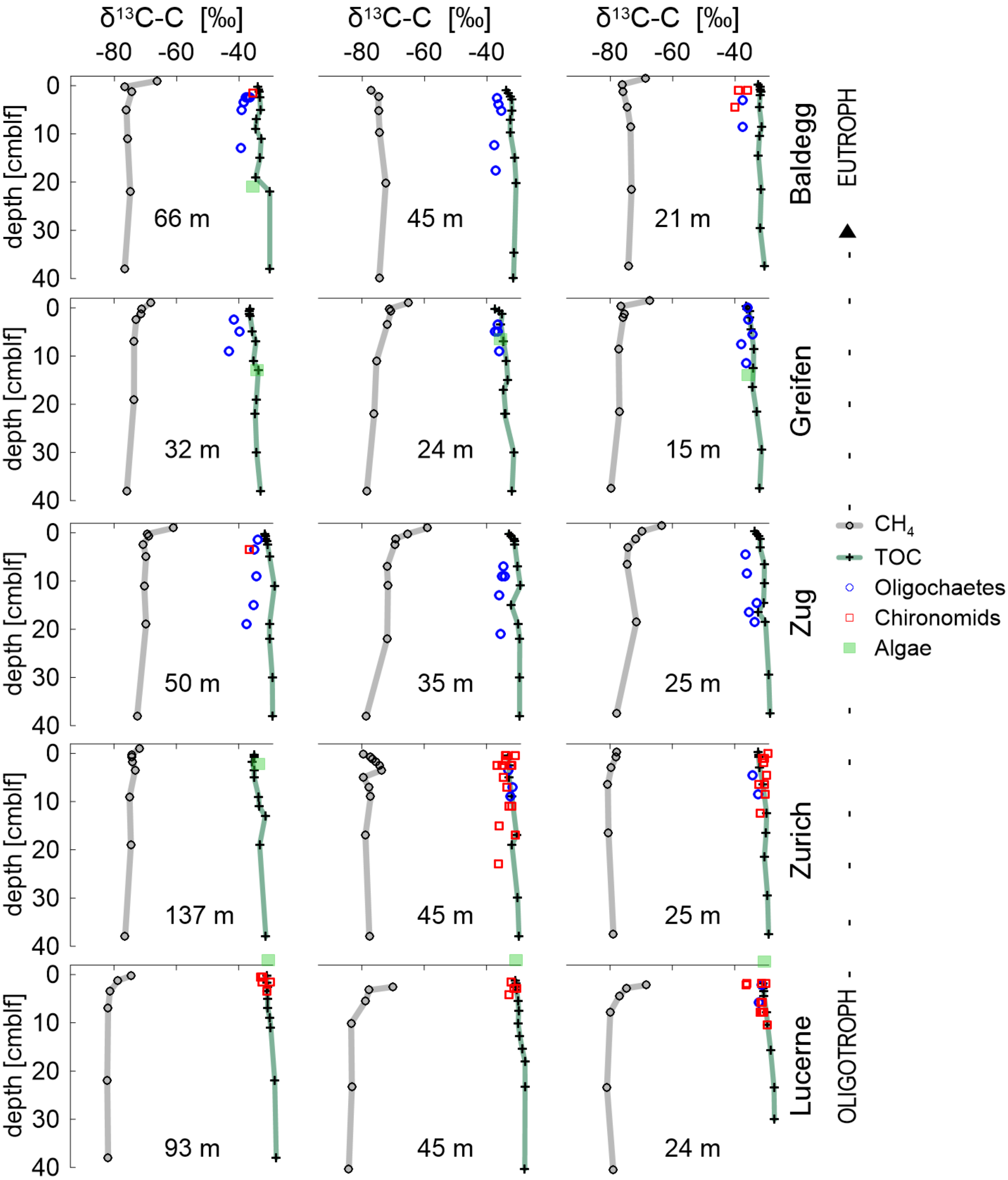


Figure S2: δ^{13}C of TOC, methane, specific sediment layers (water column phytoplankton and algal bloom sediment layers), oligochaetes and chironomid larvae vs. sediment depth (cmblf).

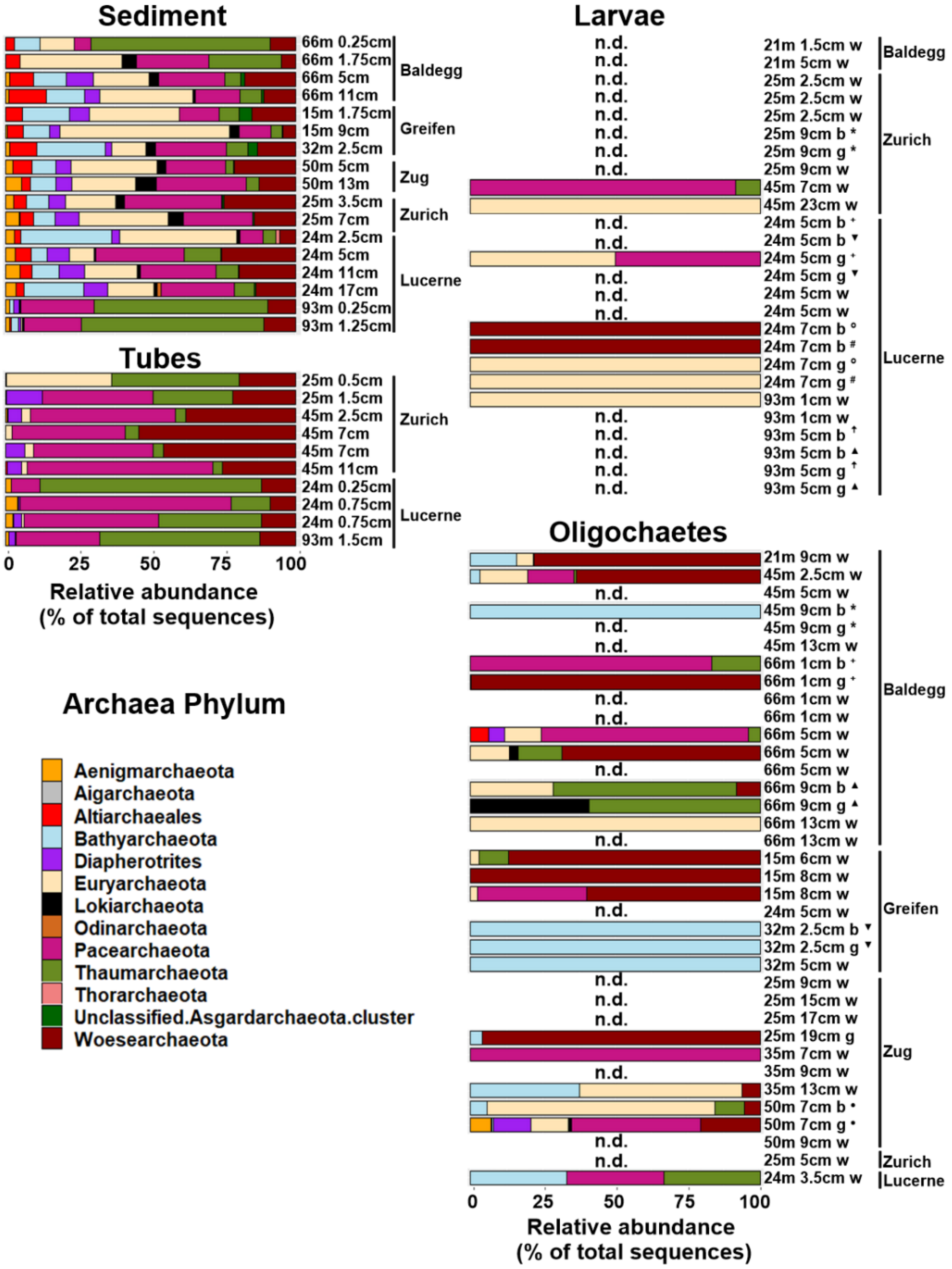
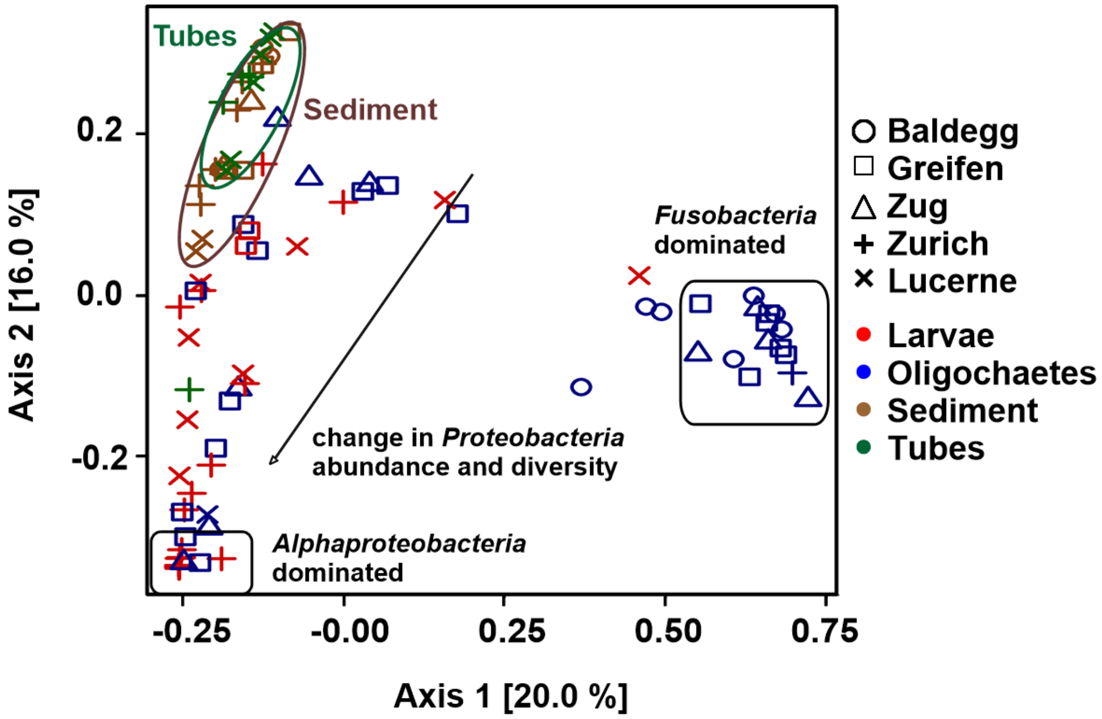
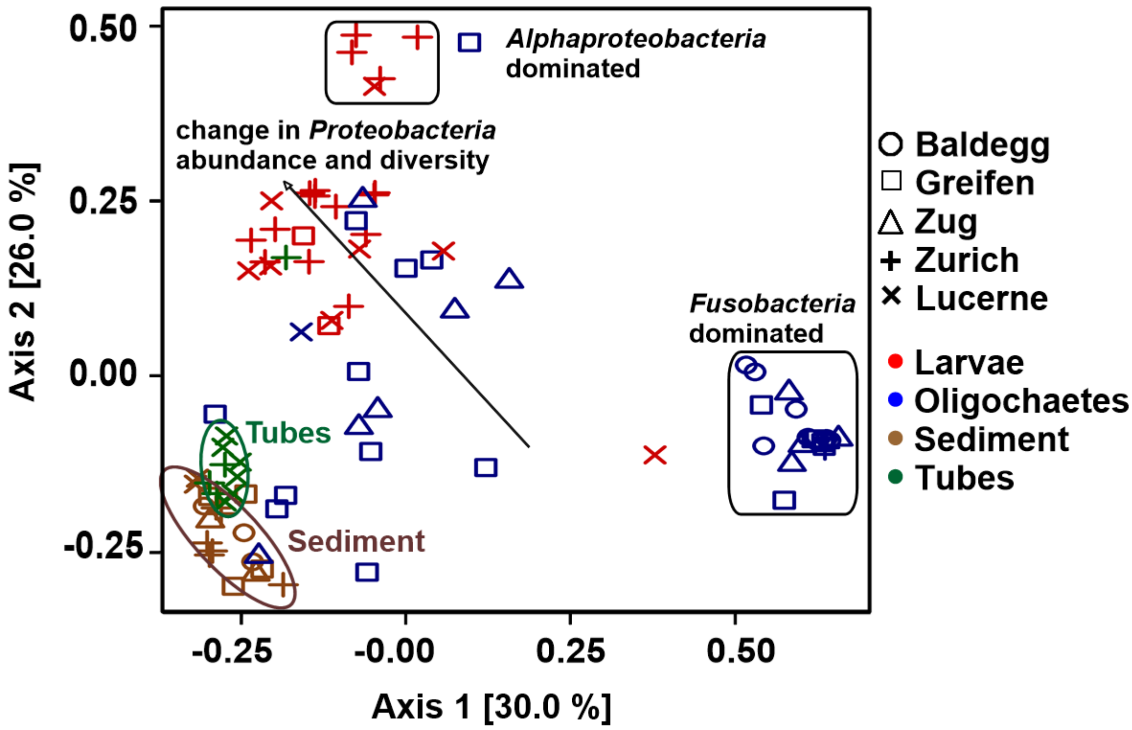


Figure S3: relative abundance of archaeal sequences (phylum level) for sediment, tubes, chironomid larvae and oligochaete samples.

Phylum



Class



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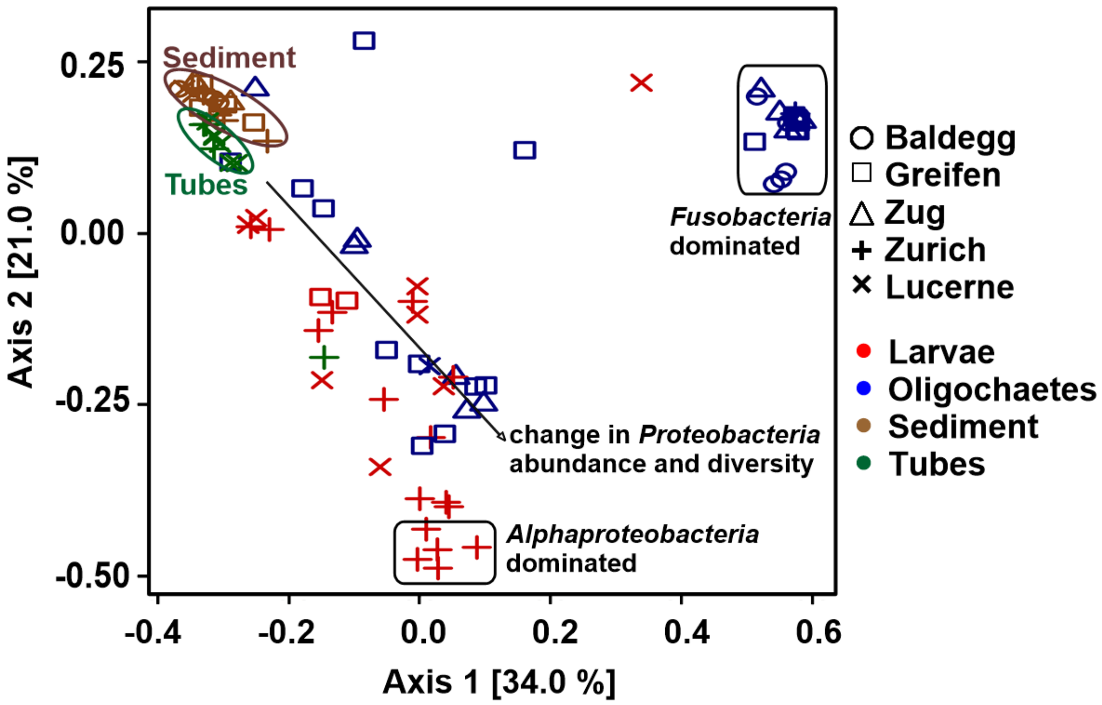
Family



Genus

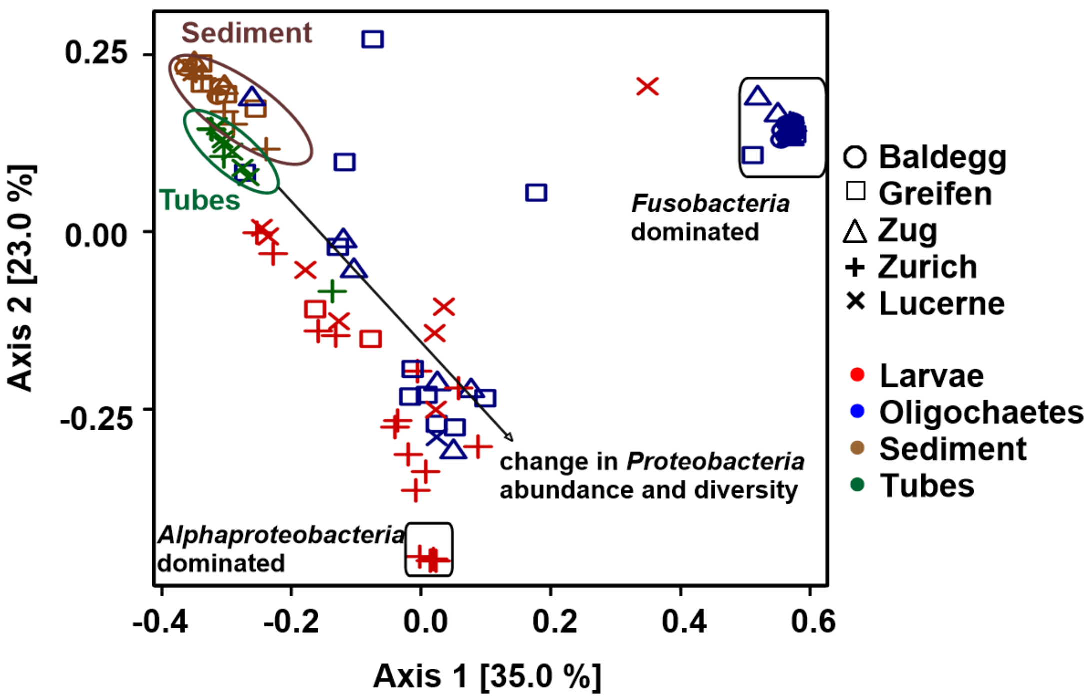


Figure S4: PCoA analysis of the relative abundance of Bacteria on the phylum, class, family and genus level. Distances are calculated using Bray Curtis distances.

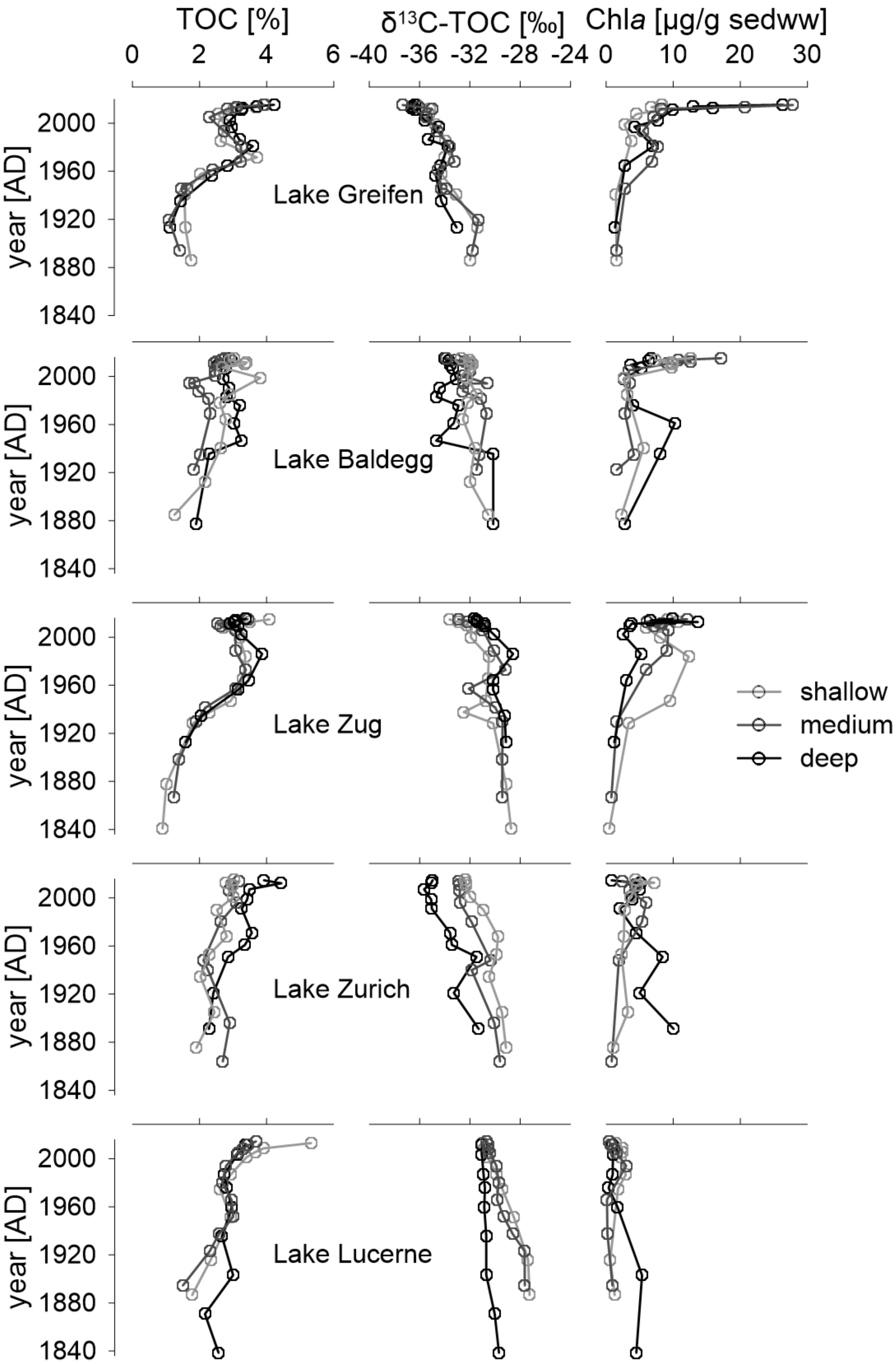


Figure S5: Total organic carbon (TOC) in [%], stable carbon isotopes of TOC (δ^{13}C-TOC) in [‰] and Chla concentrations [µg/g sedww] for each lake vs sediment age [AD]. Three stations per lake are plotted in one subplot. Light grey, open triangles= shallowest station, dark grey, closed circles = medium station, black, open circles = bottom station.

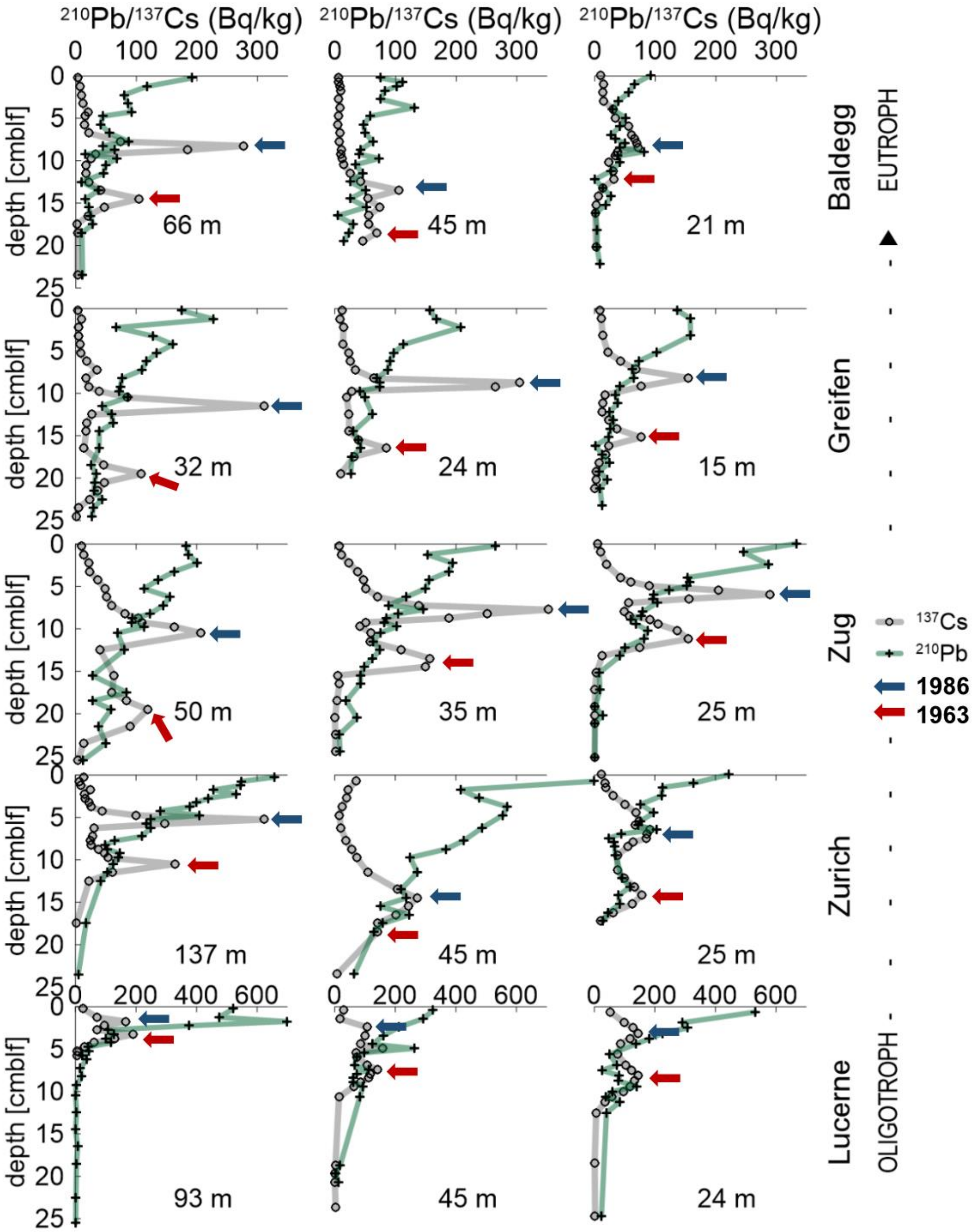
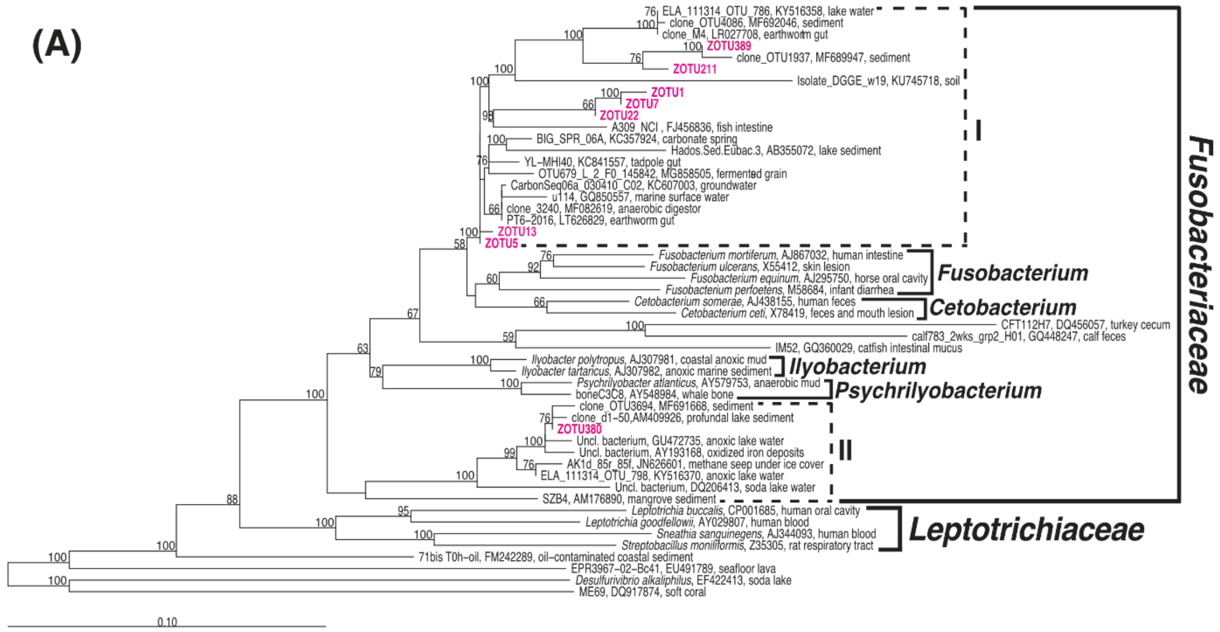
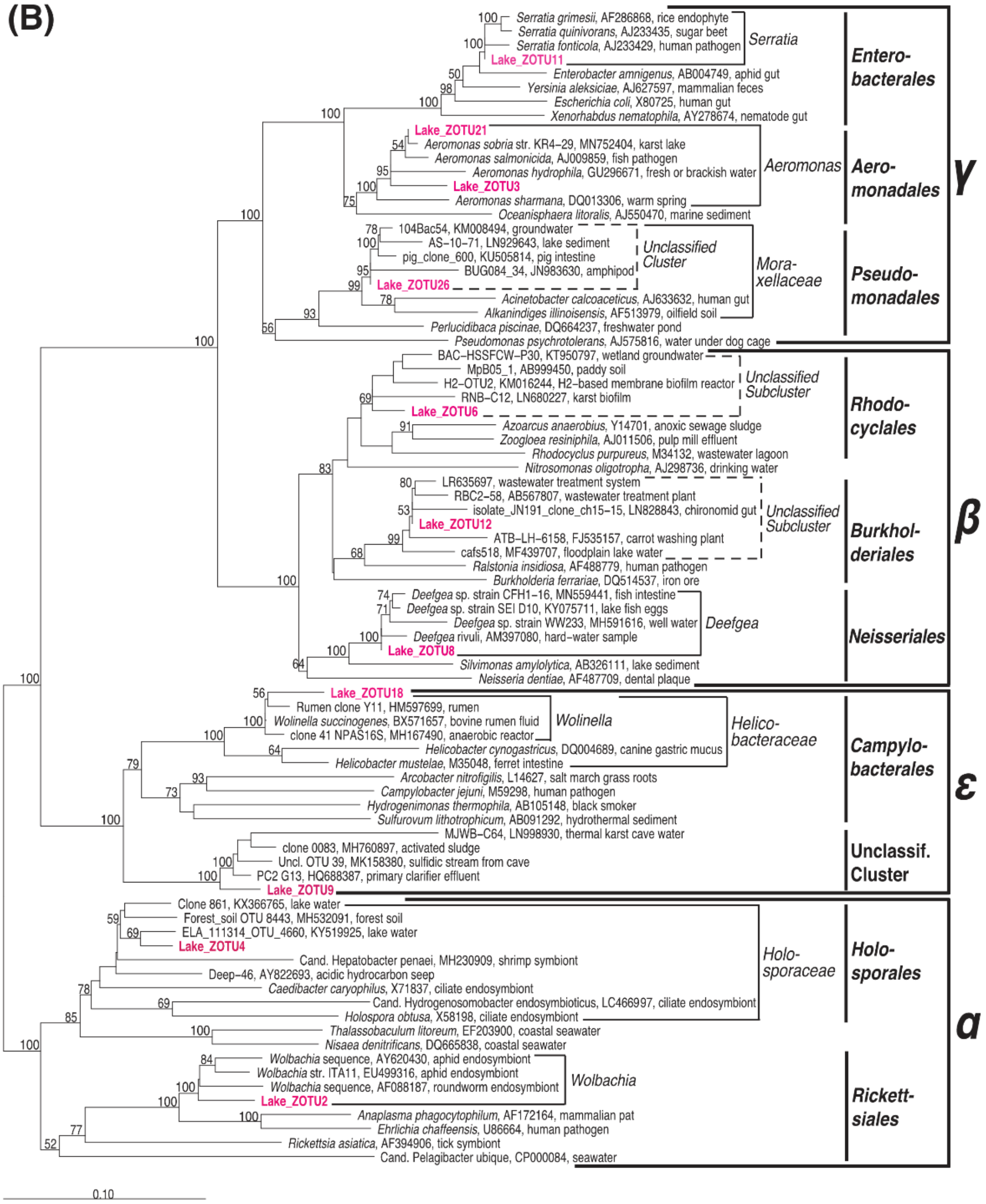


Figure S6: Profile of $^{210}Pb_{unsupported}$ and ^{137}Cs in Bq/kg, along sediment depth in centimetre below lake floor (cmblf) for each station. Blue arrow indicates the 137Cs peak due to the Chernobyl accident in 1986 and the red arrow indicates bomb testing in 1963. Please note different x-axes for Lake Lucerne.


(A)
ELA_111314_OTU_786, KY516358, lake water
clone_OTU4086, MF692046, sediment
clone_M4, LR027708, earthworm gut
ZOTU389
clone_OTU1937, MF689947, sediment
ZOTU211
Isolate_DGGE_w19, KU745718, soil
ZOTU1
ZOTU7
ZOTU22
A309_NCI , FJ456836, fish intestine
BIG_SPR_06A, KC357924, carbonate spring
Hados.Sed.Eubac.3, AB355072, lake sediment
YL-MHI40, KC841557, tadpole gut
OTU679_L_2_F0_145842, MG858505, fermented grain
CarbonSeq06a_030410_C02, KC607003, groundwater
u114, GQ850557, marine surface water
clone_3240, MF082619, anaerobic digestor
PT6-2016, LT626829, earthworm gut
ZOTU13
ZOTU5
I
Fusobacterium mortiferum, AJ867032, human intestine
Fusobacterium ulcerans, X55412, skin lesion
Fusobacterium equinum, AJ295750, horse oral cavity
Fusobacterium perfoetens, M58684, infant diarrhea
Fusobacterium
Cetobacterium somerae, AJ438155, human feces
Cetobacterium ceti, X78419, feces and mouth lesion
Cetobacterium
CFT112H7, DQ456057, turkey cecum
calf783_2wks_grp2_H01, GQ448247, calf feces
IM52, GQ360029, catfish intestinal mucus
Ilyobacter polytropus, AJ307981, coastal anoxic mud
Ilyobacter tartaricus, AJ307982, anoxic marine sediment
Ilyobacterium
Psychrilyobacter atlanticus, AY579753, anaerobic mud
boneC3C8, AY548984, whale bone
Psychrilyobacterium
clone_OTU3694, MF691668, sediment
clone_d1-50,AM409926, profundal lake sediment
ZOTU380
Uncl. bacterium, GU472735, anoxic lake water
Uncl. bacterium, AY193168, oxidized iron deposits
AK1d_85r_85f, JN626601, methane seep under ice cover
ELA_111314_OTU_798, KY516370, anoxic lake water
Uncl. bacterium, DQ206413, soda lake water
SZB4, AM176890, mangrove sediment
II
Fusobacteriaceae
Leptotrichia buccalis, CP001685, human oral cavity
Leptotrichia goodfellowii, AY029807, human blood
Sneathia sanguinegens, AJ344093, human blood
Streptobacillus moniliformis, Z35305, rat respiratory tract
Leptotrichiaceae
71bis T0h-oil, FM242289, oil-contaminated coastal sediment
EPR3967-02-Bc41, EU491789, seafloor lava
Desulfurivibrio alkaliphilus, EF422413, soda lake
ME69, DQ917874, soft coral
0.10

(B)



Serratia grimesii, AF286868, rice endophyte
Serratia quinivorans, AJ233435, sugar beet
Serratia fonticola, AJ233429, human pathogen
Lake_ZOTU11
Enterobacter amnigenus, AB004749, aphid gut
Yersinia aleksiciae, AJ627597, mammalian feces
Escherichia coli, X80725, human gut
Xenorhabdus nematophila, AY278674, nematode gut
Serratia
Entero-bacterales
Lake_ZOTU21
Aeromonas sobria str. KR4-29, MN752404, karst lake
Aeromonas salmonicida, AJ009859, fish pathogen
Aeromonas hydrophila, GU296671, fresh or brackish water
Lake_ZOTU3
Aeromonas sharmana, DQ013306, warm spring
Oceanisphaera litoralis, AJ550470, marine sediment
Aeromonas
Aero-monadales
104Bac54, KM008494, groundwater
AS-10-71, LN929643, lake sediment
pig_clone_600, KU505814, pig intestine
BUG084_34, JN983630, amphipod
Lake_ZOTU26
Acinetobacter calcoaceticus, AJ633632, human gut
Alkanindiges illinoisensis, AF513979, oilfield soil
Perlucidibaca piscinae, DQ664237, freshwater pond
Pseudomonas psychrotolerans, AJ575816, water under dog cage
Unclassified Cluster
Mora-xellaceae
Pseudo-monadales
γ
BAC-HSSFCW-P30, KT950797, wetland groundwater
MpB05_1, AB999450, paddy soil
H2-OTU2, KM016244, H2-based membrane biofilm reactor
RNB-C12, LN680227, karst biofilm
Lake_ZOTU6
Azoarcus anaerobius, Y14701, anoxic sewage sludge
Zoogloea resiniphila, AJ011506, pulp mill effluent
Rhodocyclus purpureus, M34132, wastewater lagoon
Nitrosomonas oligotropha, AJ298736, drinking water
Unclassified Subcluster
Rhodo-cyclales
LR635697, wastewater treatment system
RBC2-58, AB567807, wastewater treatment plant
isolate_JN191_clone_ch15-15, LN828843, chironomid gut
Lake_ZOTU12
ATB-LH-6158, FJ535157, carrot washing plant
cafs518, MF439707, floodplain lake water
Ralstonia insidiosa, AF488779, human pathogen
Burkholderia ferrariae, DQ514537, iron ore
Unclassified Subcluster
Burkhol-deriales
Deefgea sp. strain CFH1-16, MN559441, fish intestine
Deefgea sp. strain SEI D10, KY075711, lake fish eggs
Deefgea sp. strain WW233, MH591616, well water
Deefgea rivuli, AM397080, hard-water sample
Lake_ZOTU8
Silvimonas amylolytica, AB326111, lake sediment
Neisseria dentiae, AF487709, dental plaque
Deefgea
Neisseriales
β
Lake_ZOTU18
Rumen clone Y11, HM597699, rumen
Wolinella succinogenes, BX571657, bovine rumen fluid
clone 41 NPAS16S, MH167490, anaerobic reactor
Helicobacter cynogastricus, DQ004689, canine gastric mucus
Helicobacter mustelae, M35048, ferret intestine
Arcobacter nitrofigilis, L14627, salt march grass roots
Campylobacter jejuni, M59298, human pathogen
Hydrogenimonas thermophila, AB105148, black smoker
Sulfurovum lithotrophicum, AB091292, hydrothermal sediment
Wolinella
Helico-bacteraceae
Campylo-bacterales
MJWB-C64, LN998930, thermal karst cave water
clone 0083, MH760897, activated sludge
Uncl. OTU 39, MK158380, sulfidic stream from cave
PC2 G13, HQ688387, primary clarifier effluent
Lake_ZOTU9
Unclassif. Cluster
ε
Clone 861, KX366765, lake water
Forest_soil OTU 8443, MH532091, forest soil
ELA_111314_OTU_4660, KY519925, lake water
Lake_ZOTU4
Cand. Hepatobacter penaei, MH230909, shrimp symbiont
Deep-46, AY822693, acidic hydrocarbon seep
Caedibacter caryophilus, X71837, ciliate endosymbiont
Cand. Hydrogenosomobacter endosymbioticus, LC466997, ciliate endosymbiont
Holospora obtusa, X58198, ciliate endosymbiont
Thalassobaculum litoreum, EF203900, coastal seawater
Nisaea denitrificans, DQ665838, coastal seawater
Holo-sporaceae
Holo-sporales
Wolbachia sequence, AY620430, aphid endosymbiont
Wolbachia str. ITA11, EU499316, aphid endosymbiont
Wolbachia sequence, AF088187, roundworm endosymbiont
Lake_ZOTU2
Anaplasma phagocytophilum, AF172164, mammalian pat
Ehrlichia chaffeensis, U86664, human pathogen
Rickettsia asiatica, AF394906, tick symbiont
Cand. Pelagibacter ubique, CP000084, seawater
Wolbachia
Rickett-siales
α
0.10

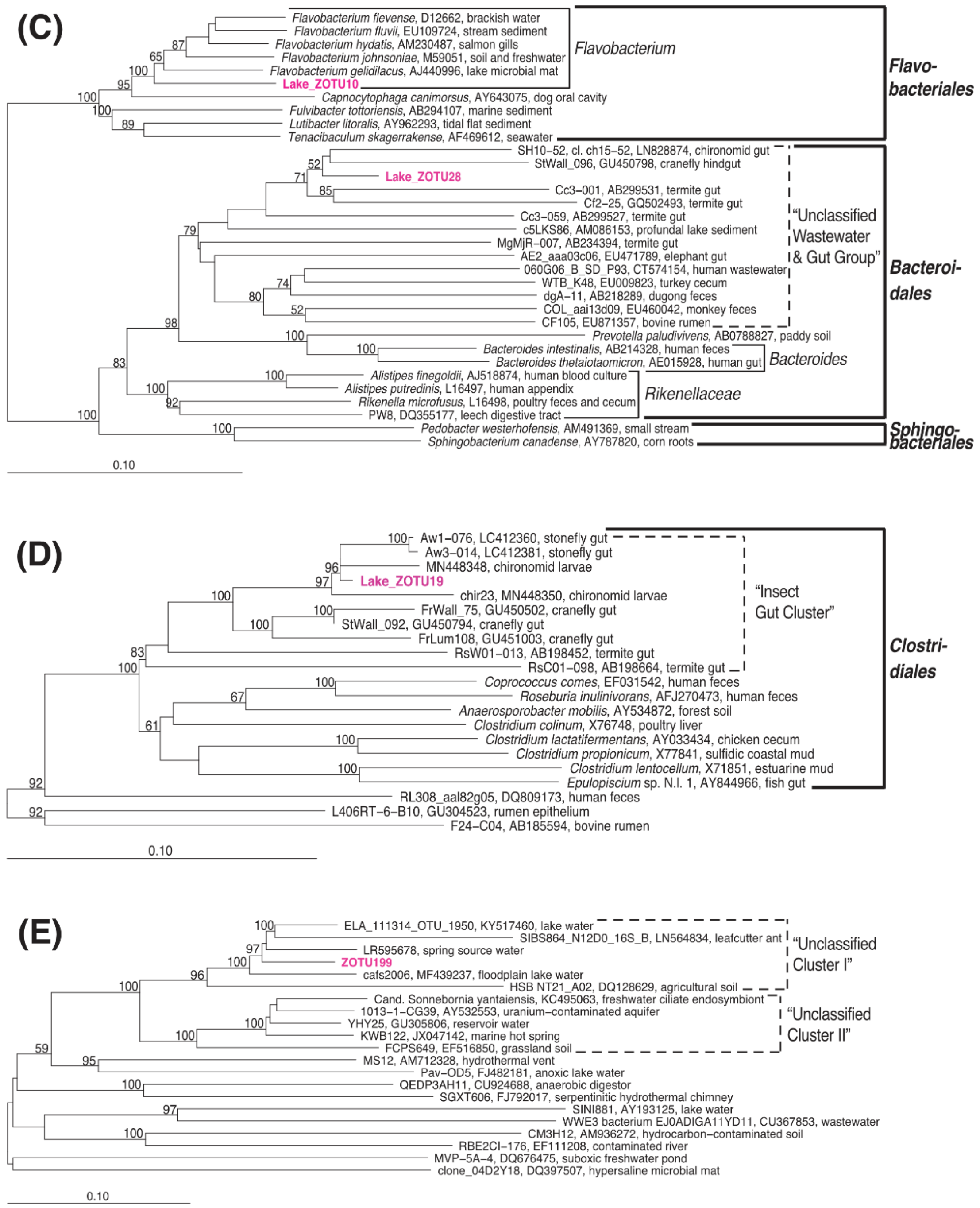


Figure S7: Phylogenetic assignment for sequences of Fusobacteria (A), Proteobacteria (B), Bacteroidetes (C), Firmicutes (D) and Parcubacteria (E) performed in ARB (please see SI Table S8). The trees show IDs and source environments of the closest related environmental DNA sequences in black, the sequences detected in this study are marked in magenta.

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