Supplement of

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

Annika Fiskal et al.

Correspondence to: Annika Fiskal (annikafiskal@gmail.com) and Mark A. Lever (mark.lever@usys.ethz.ch)

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Supplementary Information

Table S1: qPCR primers and standards and their corresponding references

<table>
<thead>
<tr>
<th>Target</th>
<th>Primer</th>
<th>Sequence 5' - 3'</th>
<th>Reference</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archaeal 16S rRNA</td>
<td>Arc915F_mod</td>
<td>AAT TGG CGG GGG AGC AC</td>
<td>Cadillo-Quiroz et al. (2006)</td>
<td>Thermoplasma acidophilum</td>
</tr>
<tr>
<td>Bacterial 16S rRNA</td>
<td>Bac908F_mod</td>
<td>AAC TCA AAK GAA TTG ACG GG</td>
<td>Lever et al. (2015)</td>
<td>Desulfitotignum phospitoxidans</td>
</tr>
<tr>
<td>pmoA</td>
<td>A189F</td>
<td>GGN GAC TGG GAC TTC TGG</td>
<td>Holmes et al. (1995)</td>
<td>Methyllococcus capsulatus</td>
</tr>
<tr>
<td>mcrA</td>
<td>Mlas_F</td>
<td>GGT GGT GTM GGD TTC ACM CAR TA</td>
<td>Steinberg and Regan (2009)</td>
<td>Methanocorpusculum parvum</td>
</tr>
</tbody>
</table>

Table S2: qPCR protocols for each primer pair.

<table>
<thead>
<tr>
<th>Primer target:</th>
<th>Arc</th>
<th>Bac</th>
<th>pmoA</th>
<th>mcrA</th>
</tr>
</thead>
<tbody>
<tr>
<td>qPCR step</td>
<td>time (min:s)</td>
<td>primer-specific temperature (°C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Initial Activation</td>
<td>05:00</td>
<td>Always 95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Denaturation</td>
<td>00:10</td>
<td>Always 95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Annealing</td>
<td>00:30</td>
<td>55</td>
<td>60 (62) 52</td>
<td>56</td>
</tr>
<tr>
<td>4. Polymerization</td>
<td>00:15</td>
<td>Always 72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Acquisition</td>
<td>00:05</td>
<td>81</td>
<td>82</td>
<td>80</td>
</tr>
<tr>
<td>Cycle repeats step 2-5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Denaturation</td>
<td>01:15</td>
<td>Always 95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Acquisition</td>
<td>continuous</td>
<td>55-95</td>
<td>60-95</td>
<td>60-95</td>
</tr>
<tr>
<td>8. Cooling</td>
<td>∞</td>
<td>Always 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 |
| H₂O (mol. grade) | 14.625 µl | 16.875 µl | 12.375 µl |
| Template | 2 µl | 1 µl | 2 µl |

(B) Temperature (°C) / Time (min:s)

<table>
<thead>
<tr>
<th>Primer target</th>
<th>Boost</th>
<th>Tail</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activation</td>
<td>95 / 05:00</td>
<td>95 / 02:00</td>
<td>95 / 02:00</td>
</tr>
<tr>
<td>Denaturation</td>
<td>98 / 00:20</td>
<td>95 / 00:20</td>
<td>95 / 00:20</td>
</tr>
<tr>
<td>Annealing</td>
<td>49 / 00:30</td>
<td>49 / 00:30</td>
<td>55 / 00:40</td>
</tr>
<tr>
<td>Polymerization</td>
<td>72 / 00:30</td>
<td>72 / 00:30</td>
<td>72 / 00:30</td>
</tr>
<tr>
<td>Denaturation</td>
<td>72 / 05:00</td>
<td>72 / 05:00</td>
<td>72 / 05:00</td>
</tr>
<tr>
<td>Cooling</td>
<td>4 / ∞</td>
<td>4 / ∞</td>
<td>4 / ∞</td>
</tr>
</tbody>
</table>
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)

<table>
<thead>
<tr>
<th>Lake</th>
<th>Station</th>
<th>Type</th>
<th>depth</th>
<th>size or feature</th>
<th>$\delta^{13}$C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucerne</td>
<td>Shore</td>
<td>phytoplankton</td>
<td>surface</td>
<td>&gt; 50 µm</td>
<td>-26.3*</td>
</tr>
<tr>
<td>Lucerne</td>
<td>Shore</td>
<td>phytoplankton</td>
<td>surface</td>
<td>&gt; 100 µm</td>
<td>-29.4*</td>
</tr>
<tr>
<td>Lucerne</td>
<td>Shore</td>
<td>phytoplankton</td>
<td>surface</td>
<td>&gt; 20 µm</td>
<td>-30.1</td>
</tr>
<tr>
<td>Lucerne</td>
<td>Shore</td>
<td>phytoplankton</td>
<td>surface</td>
<td>&gt; 20 µm</td>
<td>-19.5*</td>
</tr>
<tr>
<td>Lucerne</td>
<td>Shore</td>
<td>phytoplankton</td>
<td>surface</td>
<td>&gt; 20 µm</td>
<td>-31.2</td>
</tr>
<tr>
<td>Lucerne</td>
<td>Shore</td>
<td>phytoplankton</td>
<td>surface</td>
<td>20-100 µm</td>
<td>-29.5*</td>
</tr>
<tr>
<td>Lucerne</td>
<td>Shore</td>
<td>phytoplankton</td>
<td>surface</td>
<td>&gt; 50 µm</td>
<td>-30.3</td>
</tr>
<tr>
<td>Lucerne</td>
<td>Shore</td>
<td>phytoplankton</td>
<td>surface</td>
<td>&gt; 50 µm</td>
<td>-21.1*</td>
</tr>
<tr>
<td>Baldegg</td>
<td>1</td>
<td>sediment</td>
<td>21 cm</td>
<td>layer</td>
<td>-35.4</td>
</tr>
<tr>
<td>Zurich</td>
<td>1</td>
<td>sediment</td>
<td>2-2.5 cm</td>
<td>algal bloom</td>
<td>-33.7</td>
</tr>
<tr>
<td>Greifen</td>
<td>1</td>
<td>sediment</td>
<td>13</td>
<td>layer</td>
<td>-34.1</td>
</tr>
<tr>
<td>Zurich</td>
<td>3</td>
<td>sediment</td>
<td>18.5 cm</td>
<td>sediment with plant material</td>
<td>-29.1</td>
</tr>
<tr>
<td>Zurich</td>
<td>3</td>
<td>sediment</td>
<td>18.5 cm</td>
<td>plant material (leaves, wood)</td>
<td>-29.2</td>
</tr>
<tr>
<td>Greifen</td>
<td>3</td>
<td>sediment</td>
<td>14-15 cm</td>
<td>layer</td>
<td>-35.7</td>
</tr>
<tr>
<td>Baldegg</td>
<td>1</td>
<td>sediment</td>
<td>21 cm</td>
<td>brighter layer</td>
<td>-35.6</td>
</tr>
</tbody>
</table>

### (B)

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

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 (*).

<table>
<thead>
<tr>
<th>Lake</th>
<th>Oligochaetes (m²)</th>
<th>Chironomid Larvae (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucerne</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Station 1</td>
<td>170</td>
<td>1019</td>
</tr>
<tr>
<td>Station 2</td>
<td>57</td>
<td>340</td>
</tr>
<tr>
<td>Station 3</td>
<td>0</td>
<td>566</td>
</tr>
<tr>
<td>Average (±SD)</td>
<td>75 (±86)</td>
<td>641 (±346)</td>
</tr>
<tr>
<td>Zurich</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Station 1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Station 2</td>
<td>906</td>
<td>962</td>
</tr>
<tr>
<td>Station 3</td>
<td>1302</td>
<td>736</td>
</tr>
<tr>
<td>Average (±SD)*</td>
<td>1104 (±280)</td>
<td>849 (±160)</td>
</tr>
<tr>
<td>Zug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Station 1</td>
<td>1132</td>
<td>57</td>
</tr>
<tr>
<td>Station 2</td>
<td>1245</td>
<td>0</td>
</tr>
<tr>
<td>Station 3</td>
<td>1641</td>
<td>57</td>
</tr>
<tr>
<td>Average (±SD)</td>
<td>1340 (±267)</td>
<td>38 (±33)</td>
</tr>
<tr>
<td>Greifen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Station 1</td>
<td>3339</td>
<td>0</td>
</tr>
<tr>
<td>Station 2</td>
<td>962</td>
<td>0</td>
</tr>
<tr>
<td>Station 3</td>
<td>3736</td>
<td>0</td>
</tr>
<tr>
<td>Average (±SD)</td>
<td>2679 (±1500)</td>
<td>-</td>
</tr>
<tr>
<td>Baldegg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Station 1</td>
<td>9282</td>
<td>57</td>
</tr>
<tr>
<td>Station 2</td>
<td>4868</td>
<td>0</td>
</tr>
<tr>
<td>Station 3</td>
<td>396</td>
<td>170</td>
</tr>
<tr>
<td>Average (±SD)</td>
<td>4849 (±443)</td>
<td>75 (±86)</td>
</tr>
</tbody>
</table>
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)

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Food source and feeding mode</th>
<th>Distribution</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embolocephalus velutinus</td>
<td>Naididae: look for food at surface of sediment or other surfaces, most surface deposit feeders</td>
<td>oligo- und mesotrophic lakes, cold stenothermic species</td>
<td>Van Haaren and Soors (2013); (Martin et al. (2008); Brinkhurst (1982) Brinkhurst and Chua (1969)</td>
</tr>
<tr>
<td>Limnodrilus hoffmeisteri</td>
<td>all Tubificidae are thought to be subsurface deposit feeders that take in sediment: and mainly feed on bacteria (and algae) as main food source</td>
<td>in eu- to hypereutrophic lakes, very tolerant to oxygen deficiencies, omnipresent, wide ecological valence</td>
<td></td>
</tr>
<tr>
<td>Limnodrilus profundicola</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potamothrix hammoniensis</td>
<td>Mostly in bigger lakes, correlates with organic part in sediment originating from algae, omnipresent species with wide ecological valence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potamothrix veydovskyi</td>
<td>indicative for mid to high pollution, eutrophic conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tubifex tubifex</td>
<td>Widespread. Often dominant under eutrophic or highly oligotrophic conditions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxa</td>
<td>Food sources and feeding mode</td>
<td>Distribution</td>
<td>Reference</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Sergentia coracina</td>
<td>mainly detritus feeder (gathering collector), also filter feeding of sedimented fine particulate OM, stretch out of tubes and feed from surrounding mud, mud dwellers.</td>
<td>mesotrophic systems</td>
<td>Pillot (2009)</td>
</tr>
<tr>
<td>Paracladopelma laminatum</td>
<td>mainly predators</td>
<td>Less Fe(II) tolerant &lt; 0.2 mg Fe(II)/L, eutrophic lakes, rarely in oligotrophic lakes, tolerant of organic loading</td>
<td>Pillot (2009)</td>
</tr>
<tr>
<td>Procladius sp.</td>
<td>mainly predators, also detritus feeding of algae (gathering collector), prey are small crustaceans and later in life cycle chironomidae and oligochaetes.</td>
<td>in mineral and organic sediment, stagnant and slow flow types, warm water chironomid, lower critical O2 concentrations</td>
<td>Pillot (2009) Vallenduuk and Pillot (2007) Brodersen et al. (2004)</td>
</tr>
<tr>
<td>Tanytarsus norvegicus</td>
<td>mainly detritus feeders (gathering collector), also grazing (scrapers, raspers) and filter feeding of sedimented fine particulate OM, build tubes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macropelopia fehlmanni</td>
<td>mainly predacious, also detritus feeding, prey are mainly chironomidae, plecoptera, copeopoda, detritus</td>
<td></td>
<td>Vallenduuk and Pillot (2007)</td>
</tr>
<tr>
<td>Chironomus riparius/piger gr.</td>
<td>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)</td>
<td>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 O2 concentrations</td>
<td>Pillot (2009) Stief et al. (2005) Goedkoop et al. (2006) Brodersen et al. (2004)</td>
</tr>
<tr>
<td>Alblabesmyia monilis</td>
<td>mainly predators, also detritus feeding, actively attacking chironomidae, oligochaetes and partially cladocera but also dead prey (diatoms, detritus)</td>
<td>warm water chironomid, lower critical O2 concentrations</td>
<td>Vallenduuk and Pillot (2007) Chaloner and Wotton (1996)</td>
</tr>
<tr>
<td>Tanytarsus sp.</td>
<td>mainly detritus feeding, but also grazing and filter feeding of sedimented fine particulate OM, build tubes</td>
<td>oligo to mesotrophic lakes (Saether, 1980)</td>
<td></td>
</tr>
<tr>
<td>Micropsectra sp.</td>
<td>mainly detritus feeding, but also grazing and filter feeding of sedimented fine particulate OM</td>
<td>cold water chironomid</td>
<td>Saether (1980)</td>
</tr>
<tr>
<td>Stempellina bausei</td>
<td>grazing and detritus feeding, of epilithal algal tissue, biofilm, partially POM (endo and epilithal algal tissue, partially living plant tissue)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthocladiinae gen. sp.</td>
<td>mainly algae</td>
<td></td>
<td>Stevenson et al. (1996)</td>
</tr>
<tr>
<td>Polypedilum nubeculosum</td>
<td>mainly detritus feeding, but also grazing and filter feeding of sedimented fine particulate OM, Bacteria seem to be most important food (Moore, 1979)</td>
<td>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</td>
<td>Pillot (2009) Moore (1979)</td>
</tr>
<tr>
<td>Chironomus sp.</td>
<td>mainly filter feeding, also shredders and grazers of suspended FPOM, CPOM, prey, build tubes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chironomus commutatus</td>
<td>mainly filter feeding, also shredders and grazers of suspended FPOM, CPOM, prey, build tubes</td>
<td>More common in stagnant water, can stand low O2 conditions</td>
<td>Pillot (2009)</td>
</tr>
</tbody>
</table>
Table S7: Depth distribution of oligochaete (A) and chironomid (B) species in each lake

A: Oligochaetes

<table>
<thead>
<tr>
<th>Lake Baldegg</th>
<th># of individuals per species</th>
<th>Total # of individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (cm)</td>
<td>Tubificidae (+bristles)</td>
<td>Tubificidae (-bristles)</td>
</tr>
<tr>
<td>0-1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1-2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2-3</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>4-6</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>6-8</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>8-10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lake Greifen</th>
<th># of individuals per species</th>
<th>Total # of individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (cm)</td>
<td>Tubificidae (+bristles)</td>
<td>Tubificidae (-bristles)</td>
</tr>
<tr>
<td>0-1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2-3</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>3-4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4-6</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>6-8</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>8-10</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>10-12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lake Zug</th>
<th># of individuals per species</th>
<th>Total # of individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (cm)</td>
<td>Tubificidae (+bristles)</td>
<td>Tubificidae (-bristles)</td>
</tr>
<tr>
<td>0-1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2-3</td>
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**B: Larvae**

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<td>Depth (cm)</td>
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<td>T. norvegicus /piger gr.</td>
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</table>

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)

<table>
<thead>
<tr>
<th>ZOTU#</th>
<th>Classification</th>
<th># of fauna, where ZOTU enriched, broken down according to w, b, and g (range of % fraction of total reads)</th>
<th># of total fauna where ZOTU highly enriched</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fusobacteria</strong></td>
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</tr>
<tr>
<td>ZOTU389</td>
<td><em>Fusobacterium</em> Cl. I</td>
<td>LB: 1/11 w (7%)</td>
<td>LB: 5/14; LG: 5/5; LZug: 4/9;</td>
</tr>
<tr>
<td>ZOTU1</td>
<td><em>Fusobacterium</em> Cl. I</td>
<td>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%)</td>
<td>LL: 1/1</td>
</tr>
<tr>
<td>ZOTU7, 22</td>
<td><em>Fusobacterium</em> Cl. I</td>
<td>LG: 1/1 b (62%), 1/1 g (86%)</td>
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<tr>
<td>ZOTU5, 13</td>
<td><em>Fusobacterium</em> Cl. I</td>
<td>LB: 4/11 w (5-24%); LG: 1/5 w (65%)</td>
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<tr>
<td><strong>Proteobacteria</strong></td>
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<tr>
<td>ZOTU6</td>
<td>Uncl. Subcl. (Rhodocyclales)</td>
<td>LZ: 1/1 w (59%)</td>
<td>LZ: 1/1</td>
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<tr>
<td>ZOTU8</td>
<td><em>Deelfea</em> (Neisseriales)</td>
<td>LB: 1/3 g (93%)</td>
<td>LB: 1/14</td>
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<tr>
<td>ZOTU18</td>
<td><em>Wolinella</em> (Campylobacterales)</td>
<td>LZug: 1/7 w (55%)</td>
<td>LZug: 2/9</td>
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<tr>
<td>ZOTU9</td>
<td>Uncl. Cl.</td>
<td>LG: 1/5 w (31%); LZug: 1/2 b (5-69%)</td>
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<td><strong>α-Proteobacteria</strong></td>
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<tr>
<td>ZOTU4</td>
<td><em>Holosporaceae</em> (Holosporales)</td>
<td>LB: 1/11 w (93%); LZug: 2/7 w (7-60%)</td>
<td>LB: 1/14; LZug: 1/9</td>
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<td><strong>β-Proteobacteria</strong></td>
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<tr>
<td>ZOTU10</td>
<td><em>Flavobacterium</em> (Flavobacteriales)</td>
<td>LB: 4/11 w (6-10%), 1/3 g (6%); LG: 3/5 w (10-17%); LZug: 1/7 w (8%)</td>
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<td><strong>ε-Proteobacteria</strong></td>
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<td>ZOTU199</td>
<td>Uncl. Cl. I</td>
<td>LB: 2/11 w (7%); 1/3 b, 60%; 1/3 g, 5%</td>
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<tr>
<td>ZOTU10</td>
<td><em>Parcubacteria</em> (Flavobacteriales)</td>
<td>LB: 8/14; LG: 5/5; LZug: 7/9; LZ: 1/1; LL: 1/1</td>
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<tr>
<td>ZOTU#</td>
<td>Classification</td>
<td># of fauna, where ZOTU enriched, broken down according to w, b, and g (range of % fraction of total reads)</td>
<td># of total fauna where ZOTU highly enriched</td>
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<tr>
<td>ZOTU1</td>
<td>Fusobacterium Cl. I</td>
<td>LZ (1/1 b) (8%)</td>
<td>LZ (3/7 &gt;5%; 1/7 &gt;50%)</td>
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<tr>
<td>ZOTU5, 13</td>
<td>Fusobacterium Cl. I</td>
<td>LZ (2/6 w) (6-57%)</td>
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<tr>
<td><strong>Proteobacteria</strong></td>
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<td><strong>γ-Proteobacteria</strong></td>
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<tr>
<td>ZOTU11</td>
<td>Serratia (Enteromonaedaes)</td>
<td>LL (1/6 b) (83%)</td>
<td>LL (5/10 &gt;5%; 4/10 &gt;50%)</td>
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<td>ZOTU21, 3</td>
<td>Aeromonas (Aeronomonaedaes)</td>
<td>LL (1/4 w, 79%; 2/6 b, 11-78%; 2/6 g, 98-99%)</td>
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<td>ZOTU6</td>
<td>Uncl. Subcl. (Rhodocyclales)</td>
<td>LL (1/4 w) (56%)</td>
<td>LL (3/10 &gt;5%; 2/10 &gt;50%)</td>
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<td>ZOTU2</td>
<td>Wolbachia (Rickettsiadaes)</td>
<td>LZ (2/6 w), LL (1/4 w, 3/6 b) (42-71%)</td>
<td>LZ (2/7 &gt;5%; 2/7 &gt;50%; LL (5/10 &gt;5%; 4/10 &gt;50%)</td>
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<td>ZOTU28</td>
<td>Uncl. Wastewater &amp; Gut Group (Bacteroidaes)</td>
<td>LZ (1/6 w) (72%)</td>
<td>LZ (1/7 &gt;50%)</td>
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<td>ZOTU19</td>
<td>“Insect Gut Cl.” (Clostridiales)</td>
<td>LL (1/4 w, 2/6 g) (19-31%)</td>
<td>LL (3/10 &gt;5%; 0/10 &gt;50%)</td>
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<td>LB: 0/2; LZ: 3/7; LL: 9/10</td>
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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 oligochaete worms were found of which 1 was taxonomically analyzed (Potamothrix vejdoskyi). No Macrofauna was found at the deep station of Lake Zurich (137 m).
Figure S2: $\delta^{13}$C of TOC, methane, specific sediment layers (water column phytoplankton and algal bloom sediment layers), oligochaetes and chironomid larvae vs. sediment depth (cmlbf).
Figure S3: relative abundance of archaeal sequences (phylum level) for sediment, tubes, chironomid larvae and oligochaete samples.
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 ($\delta^{13}$C-TOC) in [%o] 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 $^{210}\text{Pb}_{\text{unsupported}}$ and $^{137}\text{Cs}$ in Bq/kg, along sediment depth in centimetre below lake floor (cmblf) for each station. Blue arrow indicates the $^{137}\text{Cs}$ 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.
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.

References


