Bacterial community composition in oligosaline Lake Bosten: low overlap of Betaproteobacteria and Bacteroidetes with freshwater ecosystems

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**Supplemental Materials**

**Table S1** Typical freshwater clusters previously reported by Crump & Hobbie (8), Eiler & Bertilsson (12), Wu et al. (57), and Zwart et al. (61).

| No. | Cluster name             | Division          | Source                  |
|-----|--------------------------|-------------------|-------------------------|
| 1   | LD12                     | α-proteobacteria  | Zwart et al. 2002       |
| 2   | Brevundimonas intermedia | α-proteobacteria  | Zwart et al. 2002       |
| 3   | CR-FL11                  | α-proteobacteria  | Zwart et al. 2002       |
| 4   | GOBB3-C201               | α-proteobacteria  | Zwart et al. 2002       |
| 5   | Novosphingobium subarctica | α-proteobacteria | Zwart et al. 2002       |
| 6   | LiUU-9-115.2             | α-proteobacteria  | Eiler & Bertilsson 2004 |
| 7   | A0904                    | α-proteobacteria  | Eiler & Bertilsson 2004 |
| 8   | LiUU-9-283.2             | α-proteobacteria  | Eiler & Bertilsson 2004 |
| 9   | GKS59                    | α-proteobacteria  | Wu et al. 2007          |
| 10  | alphaI                   | α-proteobacteria  | Wu et al. 2007          |
| 11  | ML-7-85.2                | α-proteobacteria  | Wu et al. 2007          |
| 12  | Zymomonas group          | α-proteobacteria  | Wu et al. 2007          |
| 13  | Polynucleobacter necessarius | β-proteobacteria | Zwart et al. 2002       |
| 14  | LD28                     | β-proteobacteria  | Zwart et al. 2002       |
| 15  | GKS98                    | β-proteobacteria  | Zwart et al. 2002       |
| 16  | Ralstonia pickettii      | β-proteobacteria  | Zwart et al. 2002       |
| 17  | Rhodoferax sp. BAL47     | β-proteobacteria  | Zwart et al. 2002       |
| 18  | GKS16                    | β-proteobacteria  | Eiler & Bertilsson 2004 |
| 19  | Rhodoferax fermentans    | β-proteobacteria  | Eiler & Bertilsson 2004 |
| 20  | LiUU-3-128               | β-proteobacteria  | Eiler & Bertilsson 2004 |
| 21  | LiUU-5-340.2             | β-proteobacteria  | Eiler & Bertilsson 2004 |
| 22  | LiUU-5-131               | β-proteobacteria  | Eiler & Bertilsson 2004 |
| 23  | LiUU-11-179.2            | β-proteobacteria  | Eiler & Bertilsson 2004 |
| 24  | LiUU-11-174.2            | β-proteobacteria  | Eiler & Bertilsson 2004 |
| 25  | Leptothrix               | β-proteobacteria  | Wu et al. 2007          |
| 26  | Ellin6095                | β-proteobacteria  | Wu et al. 2007          |
| 27  | Ellin6067                | β-proteobacteria  | Wu et al. 2007          |
| 28  | IRD18C08                 | β-proteobacteria  | Crump & Hobbie 2005     |
| 29  | PRD18A09                 | β-proteobacteria  | Crump & Hobbie 2005     |
| 30  | ACK-m1                   | Actinobacteria    | Zwart et al. 2002       |
| 31  | STA2-30                  | Actinobacteria    | Zwart et al. 2002       |
| 32  | MEDO-06                  | Actinobacteria    | Zwart et al. 2002       |
| 33  | URK0-14                  | Actinobacteria    | Zwart et al. 2002       |
| 34  | CL500-29                 | Actinobacteria    | Zwart et al. 2002       |
| 35  | CL120-6                  | Actinobacteria    | Eiler & Bertilsson 2004 |
| 36  | aclIV-B                  | Actinobacteria    | Eiler & Bertilsson 2004 |
| 37  | ML-5-51.2                | Actinobacteria    | Wu et al. 2007          |
| 38  | aclII-A                  | Actinobacteria    | Wu et al. 2007          |
|   |   | Kingdom          | Phylum          | Class            |
|---|---|------------------|-----------------|------------------|
| 39| acII-B| *Actinobacteria* | Wu et al. 2007  |
| 40| acII-D| *Actinobacteria* | Wu et al. 2007  |
| 41| ML-9-87.2| *Actinobacteria* | Wu et al. 2007  |
| 42| ML-7-116.2| *Actinobacteria* | Wu et al. 2007  |
| 43| ML-9-55.2| *Actinobacteria* | Wu et al. 2007  |
| 44| acI-C| *Actinobacteria* | Crump & Hobbie 2005 |
| 45| LD2| *Bacteroidetes* (CFB) | Zwart et al. 2002 |
| 46| FukuN47| *Bacteroidetes* (CFB) | Zwart et al. 2002 |
| 47| PRD01a001B| *Bacteroidetes* (CFB) | Zwart et al. 2002 |
| 48| CL500-6| *Bacteroidetes* (CFB) | Zwart et al. 2002 |
| 49| GKS2-216| *Bacteroidetes* (CFB) | Zwart et al. 2002 |
| 50| cfI| *Bacteroidetes* (CFB) | Wu et al. 2007 |
| 51| cfII| *Bacteroidetes* (CFB) | Wu et al. 2007 |
| 52| IRD18A11| *Bacteroidetes* (CFB) | Crump & Hobbie 2005 |
| 53| IRD18C10| *Bacteroidetes* (CFB) | Crump & Hobbie 2005 |
| 54| IRD18C04| *Bacteroidetes* (CFB) | Crump & Hobbie 2005 |
| 55| Methyllobacter psychrophilus| γ-proteobacteria | Zwart et al. 2002 |
| 56| LiUU-3-334.2| γ-proteobacteria | Eiler & Bertilsson 2004 |
| 57| CL120-10| *Verrucomicrobia* | Zwart et al. 2002 |
| 58| CL0-14| *Verrucomicrobia* | Zwart et al. 2002 |
| 59| FukuN18| *Verrucomicrobia* | Zwart et al. 2002 |
| 60| Sta2-35| *Verrucomicrobia* | Zwart et al. 2002 |
| 61| LD19| *Verrucomicrobia* | Zwart et al. 2002 |
| 62| LiUU-11-94| *Verrucomicrobia* | Eiler & Bertilsson 2004 |
| 63| LiUU-9-243.2| *Verrucomicrobia* | Eiler & Bertilsson 2004 |
| 64| Synechococcus 6b| Cyanobacteria | Zwart et al. 2002 |
| 65| Planktothrix agardhii| Cyanobacteria | Zwart et al. 2002 |
| 66| Aphanizomenon flos aquae| Cyanobacteria | Zwart et al. 2002 |
| 67| Microcystis| Cyanobacteria | Zwart et al. 2002 |
| 68| CL500-11| GNS | Zwart et al. 2002 |
| 69| CLO-84| OP10 | Zwart et al. 2002 |
| 70| CL500-15| *Planctomycetes* | Zwart et al. 2002 |
| 71| LiUU-9-218| *Planctomycetes* | Eiler & Bertilsson 2004 |
| 72| LiUU-11-47| *Fibrobacteres* | Eiler & Bertilsson 2004 |
Table S2. Chemical and biological parameters, DGGE bands, and Shannon diversity index ($H'$) for the two sampling stations at different water depths in Lake Bosten. Abbreviations are defined in the text.

| Sampling time | station | Depth (m) | TN (mg L$^{-1}$) | NH$_4$-N (mg L$^{-1}$) | NO$_3$-N (mg L$^{-1}$) | TP* (μg L$^{-1}$) | Cl$^-$ (mg L$^{-1}$) | SO$_4^{2-}$ (mg L$^{-1}$) | DOC (mg L$^{-1}$) | Chl a (μg L$^{-1}$) | Bacterial abundance ($10^6$ cells mL$^{-1}$) | DGGE bands | $H'$ |
|---------------|---------|-----------|------------------|---------------------|-------------------|------------------|----------------|----------------|----------------|----------------|-------------------------------|-----------|------|
| 2010-8-23     | A       | 0.5       | 1.01             | 0.09                | 0.25              | 0                | 363           | 587            | 7.4            | 1.88           | 1.23                          | 28        | 3.02 |
| 2010-8-23     | A       | 4.0       | 0.89             | 0.11                | 0.26              | 0                | 385           | 622            | 8.6            | 2.65           | 2.35                          | 25        | 2.91 |
| 2010-8-23     | A       | 8.0       | 0.91             | 0.11                | 0.24              | 0                | 387           | 624            | 15.2           | 4.40           | 3.86                          | 31        | 3.18 |
| 2010-8-23     | A       | 12.0      | 1.02             | 0.11                | 0.26              | 0                | 404           | 652            | 9.0            | 5.99           | 3.01                          | 27        | 2.95 |
| 2010-8-23     | B       | 0.5       | 0.92             | 0.18                | 0.29              | 6                | 378           | 611            | 3.9            | 1.59           | 1.63                          | 27        | 3.01 |
| 2010-8-23     | B       | 4.0       | 0.84             | 0.19                | 0.29              | 0                | 377           | 611            | 11.7           | 2.65           | 2.25                          | 24        | 2.91 |
| 2010-8-23     | B       | 8.0       | 0.88             | 0.19                | 0.30              | 9                | 385           | 622            | 6.8            | 3.34           | 3.26                          | 23        | 2.90 |
| 2010-8-23     | B       | 12.0      | 1.00             | 0.18                | 0.29              | 0                | 442           | 708            | 7.6            | 3.29           | 2.84                          | 21        | 2.75 |
| 2011-5-10     | A       | 0.5       | 0.84             | 0.38                | 0.39              | 0                | 314           | 501            | 12.5           | 2.12           | 0.57                          | 18        | 2.51 |
| 2011-5-10     | A       | 4.0       | 0.88             | 0.32                | 0.41              | 0                | 208           | 521            | 11.6           | 2.00           | 1.12                          | 20        | 2.75 |
| 2011-5-10     | A       | 8.0       | 1.06             | 0.33                | 0.41              | 0                | 427           | 622            | 11.5           | 2.30           | 1.16                          | 26        | 2.93 |
| 2011-5-10     | A       | 12.0      | 1.01             | 0.37                | 0.43              | 7                | 484           | 714            | 13.2           | 4.80           | 0.49                          | 19        | 2.58 |
| 2011-5-10     | B       | 0.5       | 0.86             | 0.41                | 0.36              | 0                | 324           | 517            | 12.3           | 2.21           | 0.90                          | 26        | 3.00 |
| 2011-5-10     | B       | 4.0       | 0.96             | 0.38                | 0.43              | 12               | 430           | 623            | 12.6           | 3.50           | 0.93                          | 30        | 3.17 |
| 2011-5-10     | B       | 8.0       | 0.88             | 0.36                | 0.43              | 0                | 528           | 778            | 12.3           | 3.90           | 1.28                          | 25        | 2.99 |
| 2011-5-10     | B       | 12.0      | 1.01             | 0.32                | 0.43              | 10               | 486           | 721            | 13.2           | 4.30           | 1.26                          | 34        | 3.23 |

*zero means below the detection limit.
Table S3. Libshuff comparisons of the homology and heterogeneity of the six libraries at different stations and at different water depths in Lake Bosten. Libraries were considered significantly different when the critical P-value <0.0017 (Singleton et al., 2001).

| Sampling season | Sample                  | Comparison | P-value   | Significantly different |
|-----------------|-------------------------|------------|-----------|-------------------------|
| August          | Aug-A-0.5m vs. Aug-A-12m| XY         | 0.0502    | no                      |
|                 |                         | YX         | 0.5011    |                         |
|                 | Aug-A-0.5m vs. Aug-B-0.5m| XY         | 0.1951    | no                      |
|                 |                         | YX         | 0.2863    |                         |
|                 | Aug-A-12m vs. Aug-B-0.5m| XY         | 0.3097    | no                      |
|                 |                         | YX         | 0.3016    |                         |
|                 | Aug-A-0.5m vs. Aug-B-12m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | <0.0001   |                         |
|                 | Aug-B-0.5m vs. Aug-B-12m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | 0.0578    |                         |
|                 | Aug-A-12m vs. Aug-B-12m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | 0.2405    |                         |
| August vs. May  | Aug-A-0.5m vs. May-A-0.5m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | <0.0001   |                         |
|                 | Aug-A-0.5m vs. May-A-12m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | <0.0001   |                         |
|                 | Aug-A-12m vs. May-A-0.5m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | <0.0001   |                         |
|                 | Aug-A-12m vs. May-A-12m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | <0.0001   |                         |
|                 | Aug-B-0.5m vs. May-A-0.5m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | <0.0001   |                         |
|                 | Aug-B-0.5m vs. May-A-12m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | <0.0001   |                         |
|                 | Aug-B-12m vs. May-A-0.5m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | <0.0001   |                         |
|                 | Aug-B-12m vs. May-A-12m| XY         | <0.0001   | yes                     |
|                 |                         | YX         | <0.0001   |                         |
| May             | May-A-0.5m vs. May-A-12m| XY         | 0.5914    | no                      |
|                 |                         | YX         | 0.0108    |                         |
(C) Firmicutes

- **Aug-A-034 (JQ327188)**
  - Sporosarcina sp. NBRC 100704 (AB681231)
  - Deep seawater clone R2A3 (JQ975830)
  - Chryseomicrobiurn imtechense MW 10 (GQ927308)
  - Coaral marine sediment clone 2216 GV0508 11H4.2 3G1 (JQ032251)
  - Planococcus rifietoensis M8 (AJ493659)
- **Aug-A-12-006 (JQ327246) 3**
- **Aug-B-012 (JQ327445) 2**
- **Aug-A-12-082 (JQ327317) 25**
- **Aug-A-005 (JQ327164)**
  - Lake Xiariinur sediment Exiguobacterium sp. H-4 (GQ404469)
  - Aug-B-026 (JQ327362) 2
  - Aug-B-12-102 (JQ327530) 18
    - Coastal sea water Exiguobacterium sp. H1622 (JF346672)
    - Flocs in brackish water clone: Bac14 Flocs (AB491820)
- **Aug-B-048 (JQ327379)**
  - Wuiliangshai Lake clone C0003 (FJ820423)

**Planococcaceae**

- **Aug-A-12-087 (JQ327322)**
  - Qinghai Lake Planococcus sp. QHL17 (JQ860232)
  - Soil Planococcus sp. OL-12 (HQ232419)
  - Permafrost Planococcus sp. BLH-5F3 (JF694794)
- **Aug-A-12-025 (JQ327457)**
  - Stream water clone C-25 (HQ860628)
  - Aug-A-12-006 (JQ327246) 3
  - Aug-B-12-012 (JQ327445) 2
  - Mumbai harbor Desemzia incerta strain NMRLDB-5 (HQ336336)
  - Soil Desemzia incerta strain T-35 (HQ202856)

**Carnobacteriaceae**

- **Aug-B-048 (JQ327379)**
  - Wuiliangshai Lake clone C0003 (FJ820423)

**Bacillales_Incertae Sedis XII**

- **Aug-B-026 (JQ327362) 2**
  - Coastal sea water Exiguobacterium sp. H1622 (JF346672)
- **Aug-B-12-102 (JQ327530) 18**
  - Coastal sea water Exiguobacterium sp. H1622 (JF346672)
  - Flocs in brackish water clone: Bac14 Flocs (AB491820)
(D) Cyanobacteria

- **Radiocystis**
  - Freshwater reservoir *Radiocystis* sp. JJ30-12 (AM710388)
  - Freshwater reservoir *Radiocystis* sp. JJ30-3 (AM710389)

- **Microcystis**
  - *Microcystis aeruginosa* 0BB35S02 (AJ635430)
  - Lake clone sa0.8 (HQ904110)
  - Lake Taihu clone AW05 (JN866820)
  - Hypersaline Mat clone SBXZ 5358 (JN436508)

- **Synechococcus 6b**
  - *Synechococcus* sp. 0BB22S05 (AJ639898)
  - *Synechococcus* sp. CENA108 (EF088334)
  - Bantou freshwater reservoir clone B-40 (HQ661206)
  - Hubian freshwater reservoir clone H-48 (HQ661262)
(E) Other phyla

| Phylum                  | Species/Origin                      | Accession Numbers               |
|-------------------------|-------------------------------------|---------------------------------|
| Actinobacteria          | Kelike Lake clone SING994 (HM129555) |                                  |
|                        | Limnoluna rubra strain MWH-EgelM2-3 (AM943659) |                                  |
|                        | Aquiluna rubra MWH-Dar4 (AJ565416) |                                  |
|                        | Aug-B-12-049 (JQ327480) |                                  |
|                        | Aug-A-054 (JQ327204) 2 |                                  |
|                        | Wuliangshuai Lake clone H0050 (FJ820369) |                                  |
|                        | Aug-B-037 (JQ327370) |                                  |
|                        | Lake Xinxinjiang Microcella sp. clone XZXXH163 (EU703405) |                                  |
|                        | Kelike Lake clone SING821 (HM129410) |                                  |
|                        | Lake Taihu actinobacterium clone TH1-7 (AM690811) |                                  |
|                        | Aug-B-12-002 (JQ327436) |                                  |
|                        | Chesapeake Bay clone 3C003645 (EU802213) |                                  |
|                        | Twin Valley Lake clone TW1-D9 (EU117981) |                                  |
|                        | Aug-B-001 (JQ327342) |                                  |
|                        | Lake Gatun clone 5C230821 (EU803274) |                                  |
|                        | Aug-B-013 (JQ327353) |                                  |
|                        | Lake Xingyunhu clone xyhfl1-45 (HM050932) |                                  |
|                        | Drinking water pipe clone 98B-1 F06 T3 (HM998739) |                                  |
|                        | Soil Deinococcus sp. HJ-30-11 (JQ511861) |                                  |
|                        | May-A-12-031 (JQ327644) 6 |                                  |
|                        | Aug-B-115 (JQ327420) |                                  |
|                        | Aug-A-060 (JQ327208) |                                  |
|                        | Aug-A-12-049 (JQ327286) |                                  |
|                        | Sillage Deinococcus sp. 37 (EU294411) |                                  |
|                        | Aug-B-12-055 (JQ327486) 4 |                                  |
|                        | Deinococcus aquaticus PB314 (DQ017708) |                                  |
|                        | Aug-A-010 (JQ327168) |                                  |
|                        | Cotton rhizosphere clone 4y-102 (FJ444759) |                                  |
|                        | Aug-B-055 (JQ327384) |                                  |
|                        | Yellowstone Lake clone YL216 (HM856576) |                                  |
|                        | LD19 (AF009974) |                                  |
|                        | May-A-12-024 (JQ327637) 2 |                                  |
|                        | Saltwater lake Opitutus sp. clone sh-xjl (JF958122) |                                  |
|                        | Lake Bosten clone BST22-5 (HQA36970) |                                  |
|                        | May-A-020 (JQ327548) 4 |                                  |
|                        | May-A-12-012 (JQ327262) |                                  |
|                        | May-A-12-026 (JQ327369) |                                  |
|                        | Lake Bosten clone BST7-32 (HQA36975) |                                  |
|                        | May-A-080 (JQ327599) 3 |                                  |
|                        | Groundwater clone NABC30V1065 (JN547160) |                                  |
|                        | Hypersaline Mat clone SBYH 1325 (JN454515) |                                  |
|                        | Aug-A-051 (JQ327281) 2 |                                  |
|                        | Aug-A-12-104 (JQ327338) |                                  |
|                        | LiUU-9-218 (AY509499) Planctomycetes |                                  |
|                        | MiYu reservoir clone MYX34 (GU365724) |                                  |
|                        | Aug-A-12-026 (JQ327264) |                                  |
|                        | Yard soil Planctomycetes sp. 1ol-3 (QJ889464) |                                  |
|                        | Activated sludge clone mesophilic alkaline-58 (GU455173) |                                  |
|                        | Aug-A-028 (JQ327183) |                                  |
|                        | Aug-A-12-086 (JQ327321) |                                  |
|                        | Lake Bosten clone BST15-87 (HQ436955) |                                  |
|                        | Alpine Lake Joeri XIII clone C8 (AJ867920) |                                  |
|                        | Lake Taihu clone JN91 (JN869008) |                                  |
|                        | May-A-008 (JQ327537) 3 |                                  |
|                        | May-A-12-073 (JQ327682) 5 |                                  |
**Figure S1** Phylogenetic trees of *α*-proteobacteria (A), *γ*-proteobacteria (B), Firmicutes (C), Cyanobacteria (D), and other phyla (E) inferred by Maximum Likelihood analysis of partial 16S rRNA gene sequences from six clone libraries in Lake Bosten. A bootstrap test with 1000 replicates was conducted, and only bootstrap values $>50\%$ are shown near nodes. Phylogenetic analyses were conducted in MEGA v5.2. Bar: 10\% of estimated sequence divergence. Red clones were obtained in August 2010, and blue clones were obtained in May 2011. For each OTU, only one representative clone from each library is shown. The GenBank accession numbers are given in parentheses, followed by the number of clones within each representative clone. The most dominant 10 OTUs (Table 2) in the tree are shown in green. The open circles (○) before the clones represent surface water samples, and the dark filled circles (●) represent bottom water samples. Brackets following clone names indicate typical freshwater clusters previously reported by Crump & Hobbie (8), Eiler & Bertilsson (12), Wu et al. (57), and Zwart et al. (61). Names in brackets following the typical freshwater clusters were tribes or lineages named by Newton and coworkers (34).