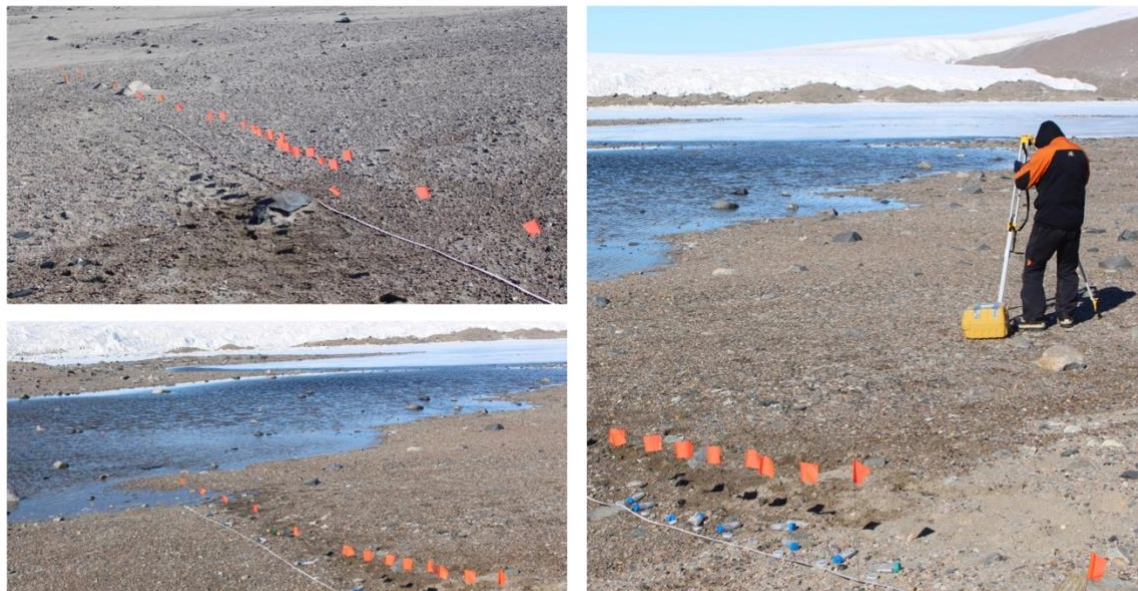
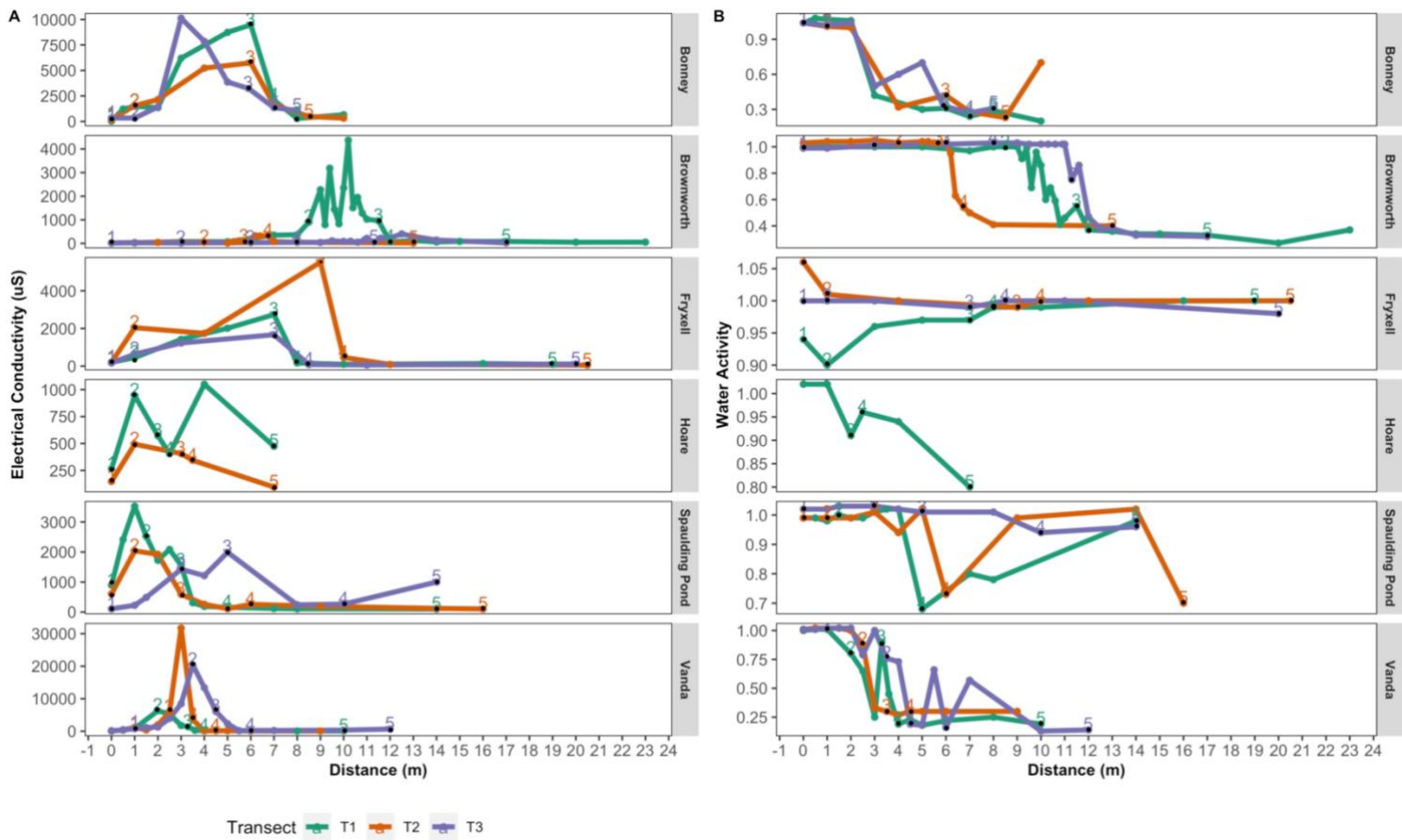


## Supplementary Material

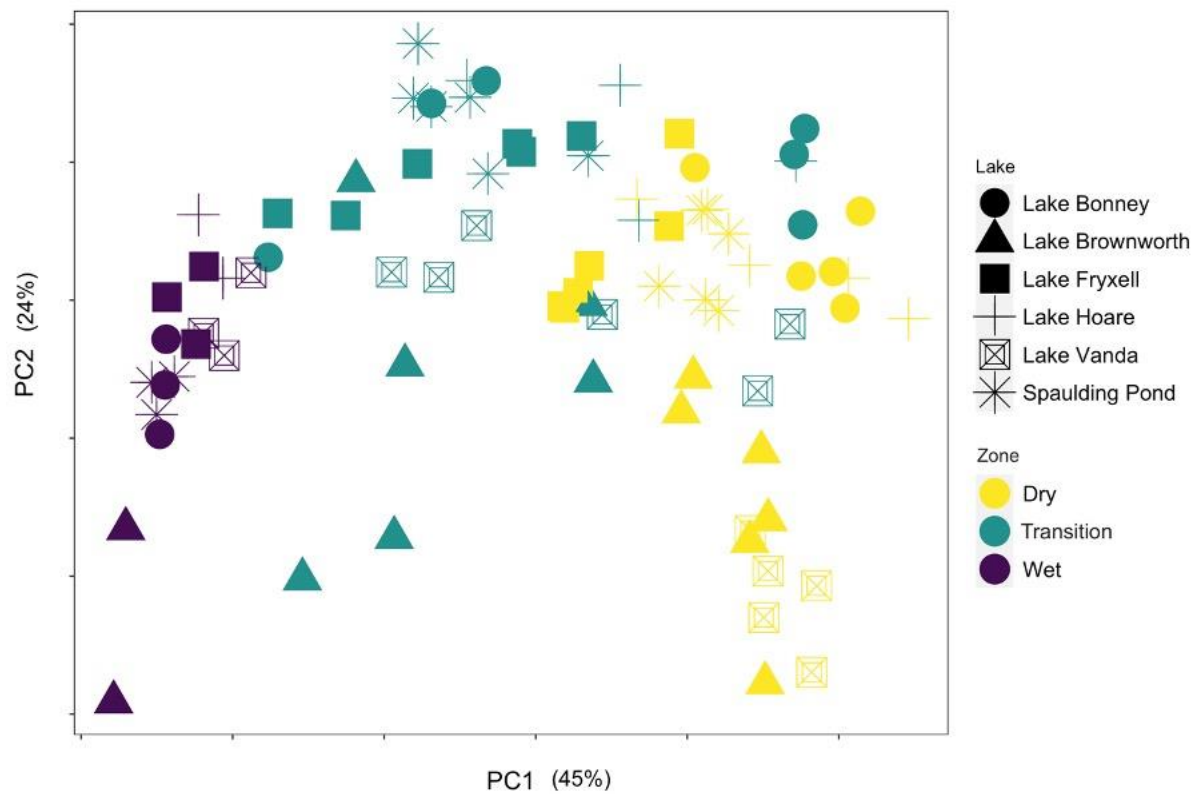
### Supplementary Figures



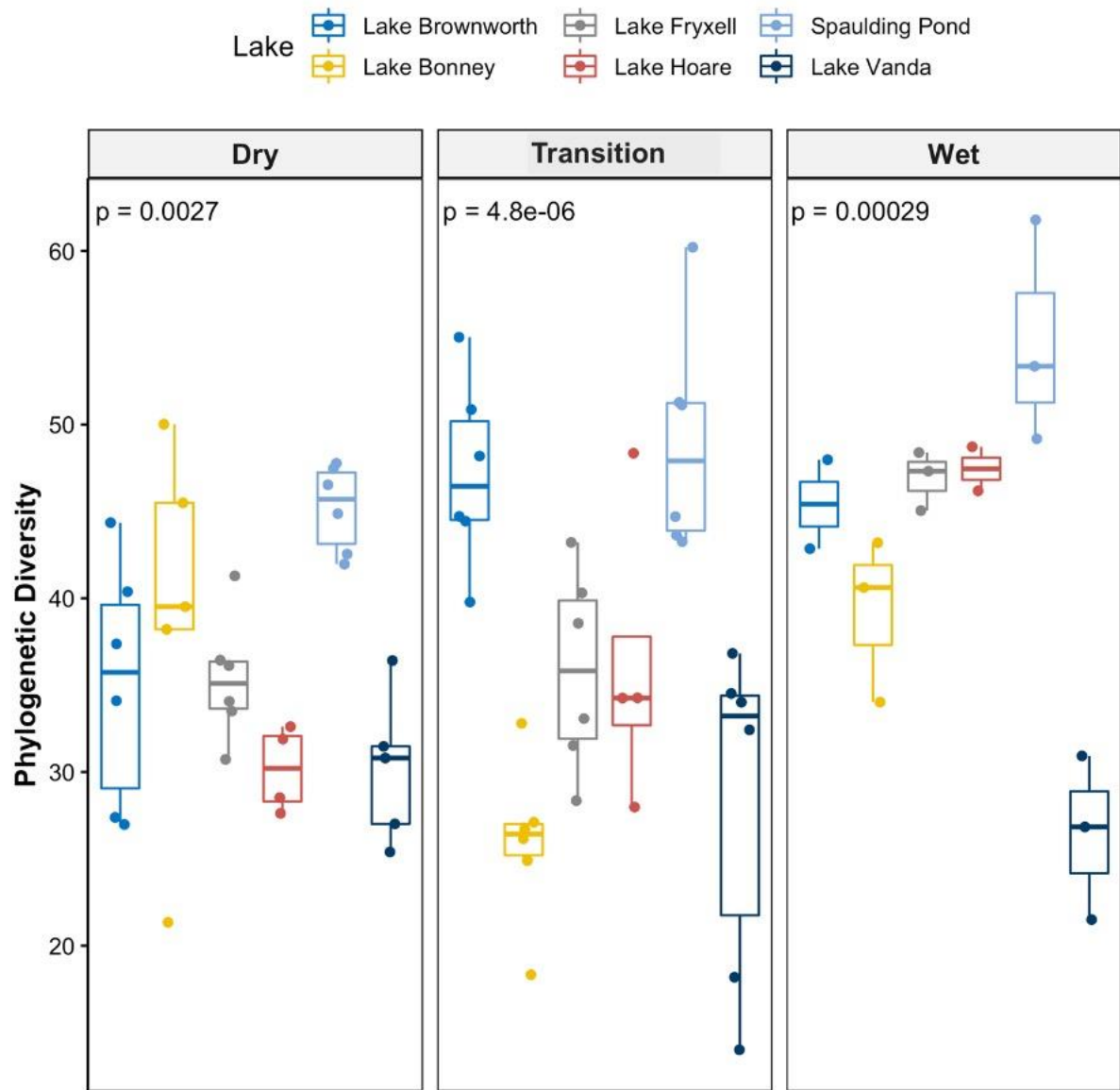
**Figure S1** – Photos of space-for-time transects defined in Lake Brownworth during 2016/2017 field season. Before determining the sampling points, geochemical parameters of water activity, conductivity, and pH were measured along several points across the wetness gradients (averaging every 50 cm from the shore of the lake into the dry soil).



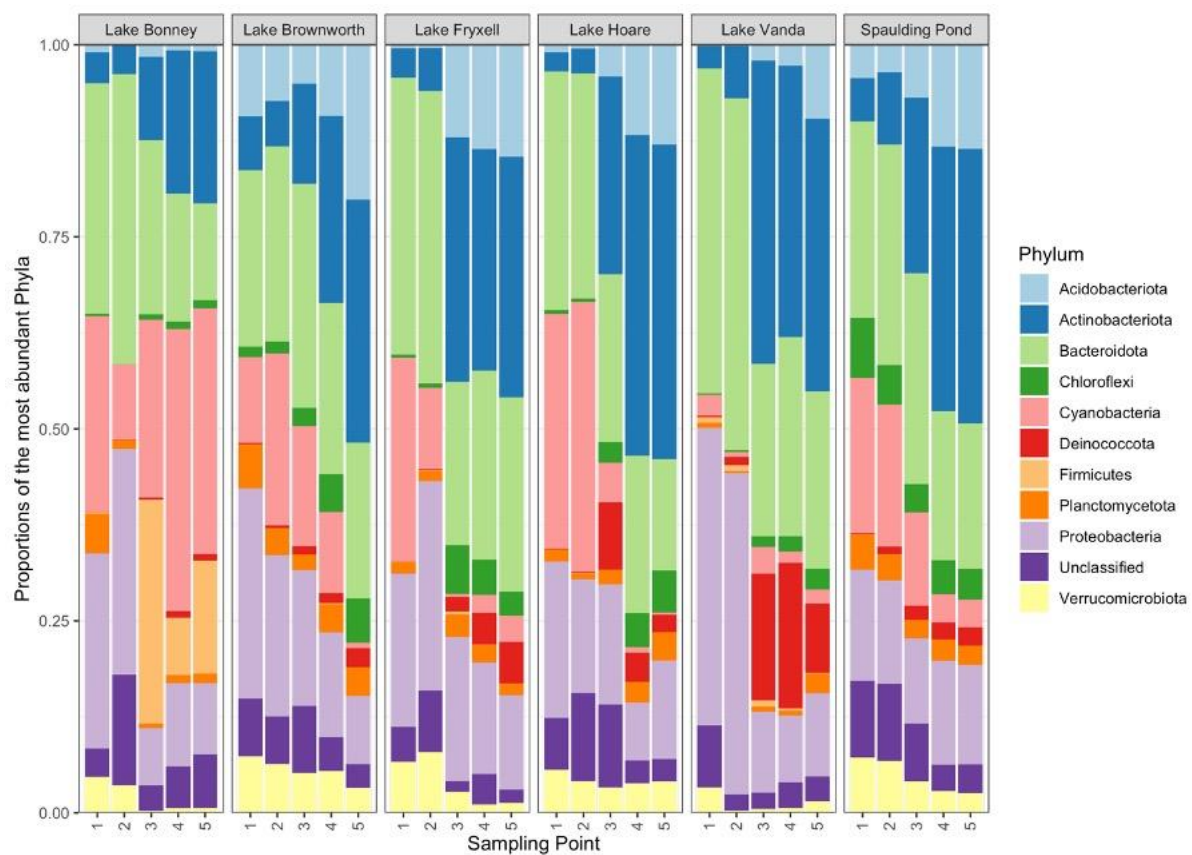
**Figure S2** – Electrical conductivity (A) and water activity (B) profiles measured along the wetness gradient before defining the sampling points in Lake Bonney, Lake Brownworth, Lake Fryxell, Lake Hoare, Spaulding Pond and Lake Vanda. The location of each sampling point across distance can be depicted in the figures by the numbers.



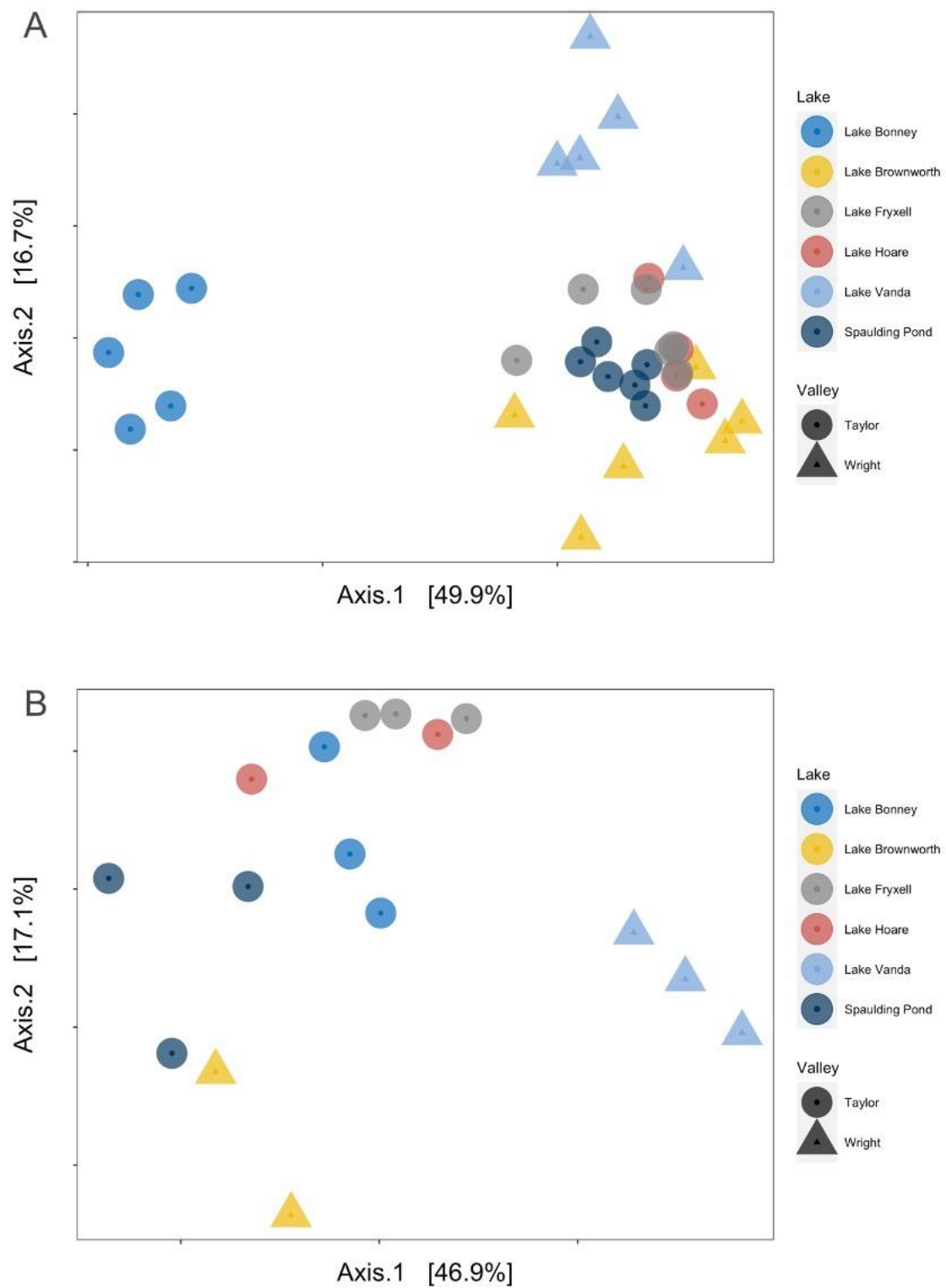
**Figure S3** – PCoA ordinations based on the samples geochemical profiles. An Euclidean distance matrix was calculated using geochemical data collected in the field (elevation, pH, conductivity, water activity, and soil moisture content) after being  $\log(x+1)$  transformed and normalized.



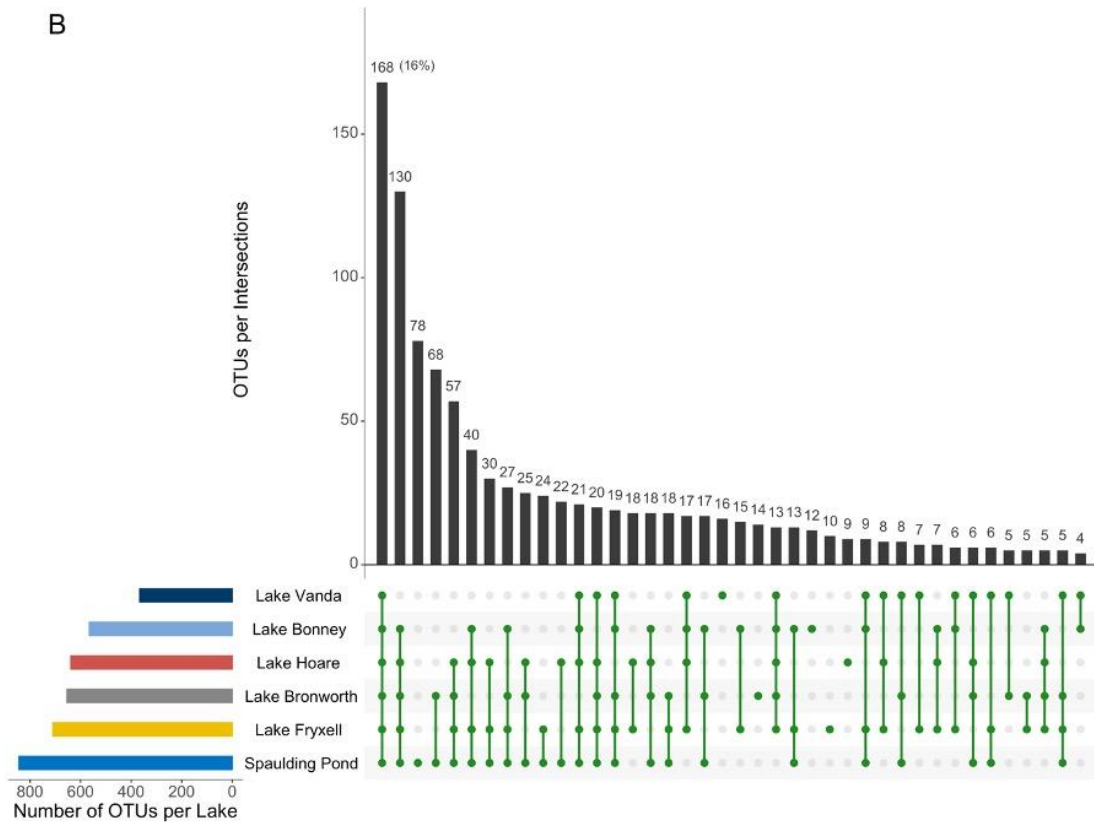
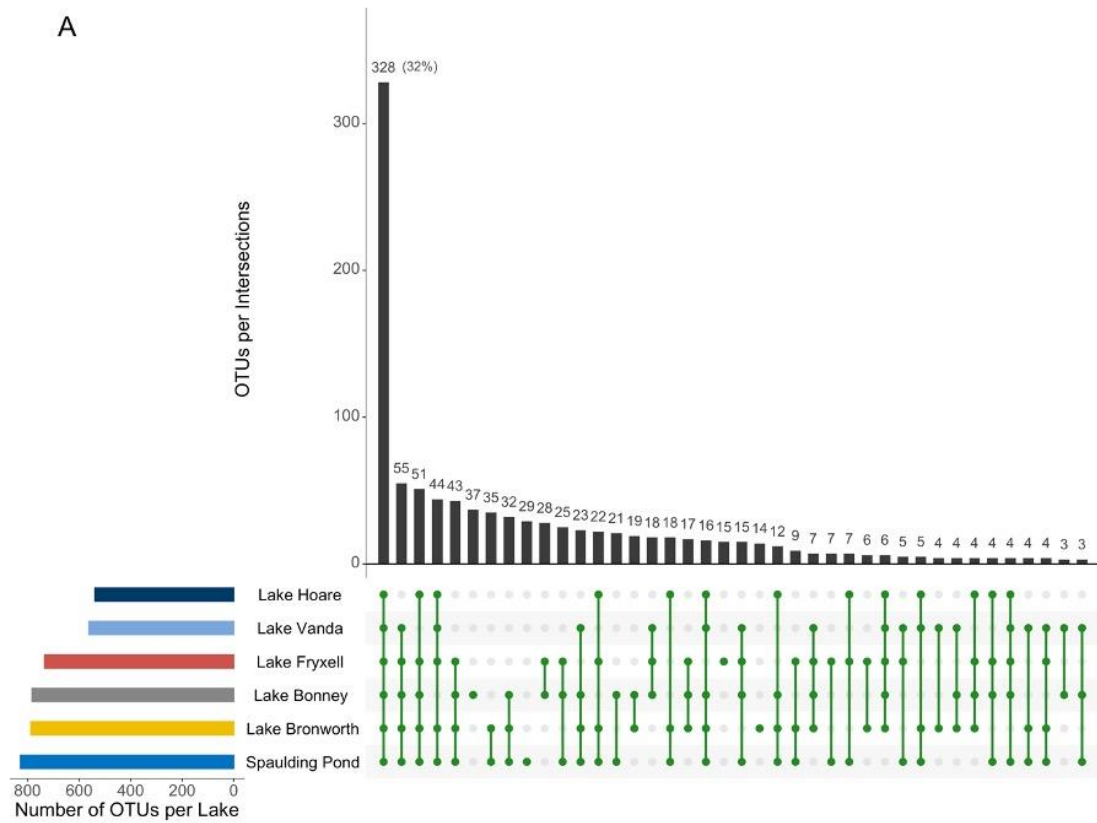
**Figure S4** - Estimated OTU phylogenetic diversity (PD) of the microbial communities between different lakes on wet, transition, and dry sections of space-for-time transects. The error bars represent standard deviations of means.



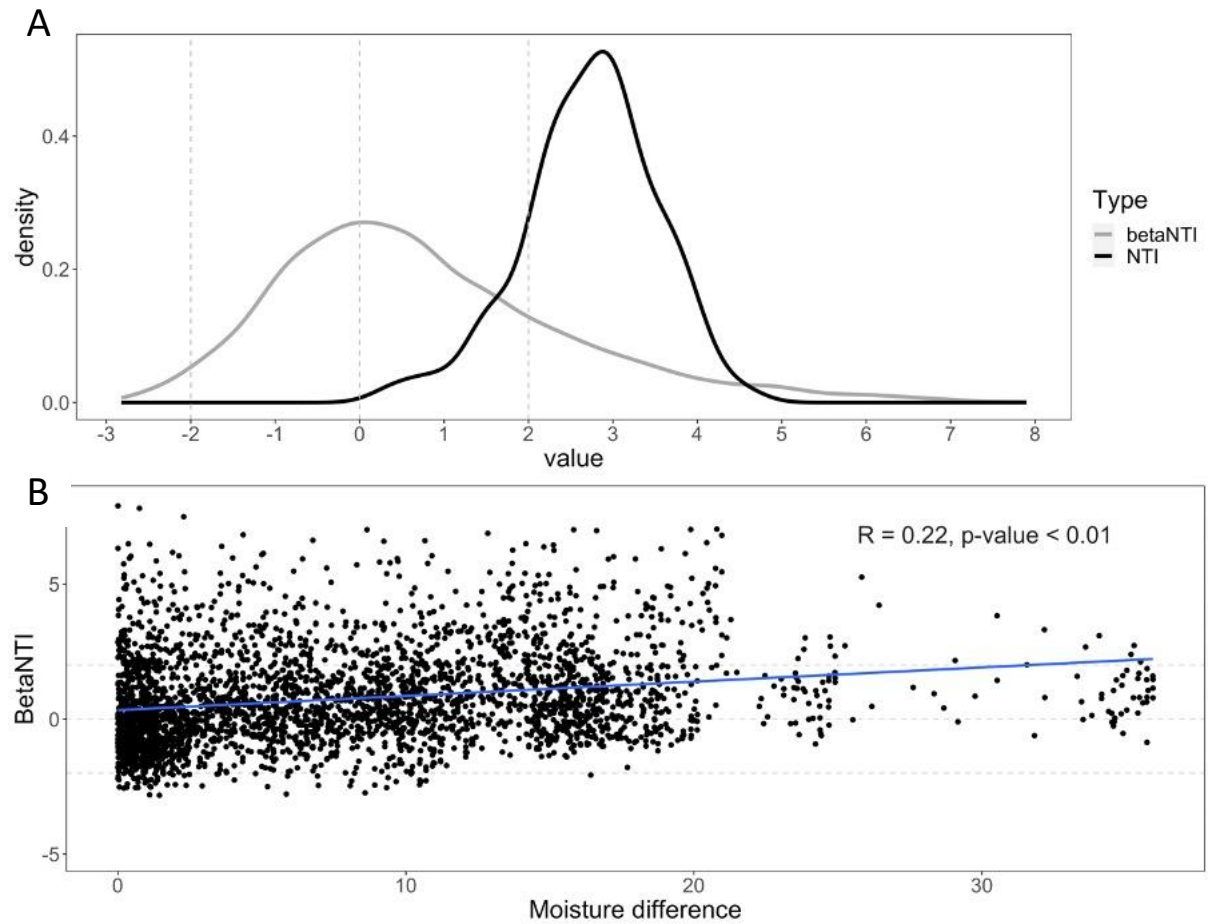
**Figure S5** - Relative abundance of the most dominant bacterial phyla along space-for-time transects from each lake.



**Figure S6** - Principal coordinate analysis (PCoA) of the microbial community compositional data from dry (A) and wet zones of all lake transects (B), using a weighted UniFrac distance matrix.



**Figure S7** –UpSet plots showing the number of OTUs shared in the dry (A) and wet zones (B) of all lake transects.



**Figure S8 – A** - density plot estimating the distributions of the nearest taxon index (NTI) and its between-community analogue ( $\beta$ NTI). Dashed grey lines at the  $-2$  and  $+2$  values delimitate the significance thresholds from the null expectation; **B** –  $\beta$ NTI values for all pairwise community comparisons regressed against the difference in moisture content between communities. The linear regression model is shown as the blue line. Dashed grey lines at the  $-2$  and  $+2$  values delimitate the significance thresholds from the null expectation.

## Supplementary Tables

**Table S1-** Raw reads, sequencing and quality filtering statistics of 16S rRNA gene reads

| ID       | DNA yield (ng/g wet soil) | Raw reads | after QC         | %   | Length | after 0.005% culling | %     | Transect | Sampling Point | Transect Section | Lake            | Valley        |
|----------|---------------------------|-----------|------------------|-----|--------|----------------------|-------|----------|----------------|------------------|-----------------|---------------|
| BT3_0    | 421                       | 71260     | 14670            | 21  | 350    | 11812                | 80.52 | BT3      | 1              | Wet              | Lake Brownworth | Wright Valley |
| BT3_13   | 226                       | 90447     | 23881            | 26  | 350    | 23704                | 99.26 | BT3      | 5              | Dry              | Lake Brownworth | Wright Valley |
| BT3_4    | 250                       | 97889     | 31299            | 32  | 350    | 28616                | 91.43 | BT3      | 2              | Transition       | Lake Brownworth | Wright Valley |
| BT3_5.75 | 119                       | 54774     | 13697            | 25  | 350    | 12706                | 92.76 | BT3      | 3              | Transition       | Lake Brownworth | Wright Valley |
| BT3_6.75 | 890                       | 67625     | 16549            | 24  | 350    | 15725                | 95.02 | BT3      | 4              | Dry              | Lake Brownworth | Wright Valley |
| BT4_0    | 338                       | 754       | all filtered out | N/A | N/A    | N/A                  | N/A   | BT4      | 1              | Wet              | Lake Brownworth | Wright Valley |
| BT4_11.3 | 283                       | 106305    | 36986            | 35  | 350    | 36375                | 98.35 | BT4      | 3              | Transition       | Lake Brownworth | Wright Valley |
| BT4_12   | 55                        | 64777     | 20699            | 32  | 350    | 20201                | 97.59 | BT4      | 4              | Dry              | Lake Brownworth | Wright Valley |
| BT4_17   | 268                       | 78018     | 23426            | 30  | 350    | 23265                | 99.31 | BT4      | 5              | Dry              | Lake Brownworth | Wright Valley |
| BT4_9    | 381                       | 74493     | 21563            | 29  | 350    | 19910                | 92.33 | BT4      | 2              | Transition       | Lake Brownworth | Wright Valley |
| BT5_0    | 34                        | 79955     | 20410            | 26  | 350    | 18982                | 93.00 | BT5      | 1              | Wet              | Lake Brownworth | Wright Valley |
| BT5_11   | 188                       | 68071     | 19455            | 29  | 350    | 18697                | 96.10 | BT5      | 5              | Dry              | Lake Brownworth | Wright Valley |
| BT5_2    | 52                        | 83741     | 24715            | 30  | 350    | 23621                | 95.57 | BT5      | 2              | Transition       | Lake Brownworth | Wright Valley |
| BT5_5    | 186                       | 100393    | 24025            | 24  | 350    | 22968                | 95.60 | BT5      | 3              | Transition       | Lake Brownworth | Wright Valley |
| BT5_6    | 225                       | 101765    | 25823            | 25  | 350    | 24260                | 93.95 | BT5      | 4              | Dry              | Lake Brownworth | Wright Valley |
| LB1_0    | 1040                      | 58481     | 20693            | 35  | 350    | 20070                | 96.99 | LBo1     | 1              | Wet              | Lake Bonney     | Taylor Valley |
| LB1_1    | 710                       | 88682     | 35015            | 39  | 350    | 34462                | 98.42 | LBo1     | 2              | Transition       | Lake Bonney     | Taylor Valley |
| LB1_6    | 1                         | 32458     | 18327            | 56  | 350    | 17934                | 97.86 | LBo1     | 3              | Transition       | Lake Bonney     | Taylor Valley |
| LB1_7    | 23                        | 44974     | 19124            | 43  | 350    | 18743                | 98.01 | LBo1     | 4              | Dry              | Lake Bonney     | Taylor Valley |
| LB1_8    | 2                         | 78858     | 43415            | 55  | 350    | 42284                | 97.39 | LBo1     | 5              | Dry              | Lake Bonney     | Taylor Valley |
| LB2_0    | 328                       | 60379     | 21580            | 36  | 350    | 20521                | 95.09 | LBo2     | 1              | Wet              | Lake Bonney     | Taylor Valley |
| LB2_1    | 338                       | 59666     | 23457            | 39  | 350    | 23272                | 99.21 | LBo2     | 2              | Transition       | Lake Bonney     | Taylor Valley |
| LB2_6    | 1                         | 6141      | 3153             | 51  | 350    | 3060                 | 97.05 | LBo2     | 3              | Transition       | Lake Bonney     | Taylor Valley |
| LB2_8.5  | 9                         | 7805      | 4095             | 52  | 350    | 4037                 | 98.58 | LBo2     | 4              | Dry              | Lake Bonney     | Taylor Valley |
| LB3_0    | 854                       | 80353     | 23225            | 29  | 350    | 22466                | 96.73 | LBo3     | 1              | Wet              | Lake Bonney     | Taylor Valley |
| LB3_1    | 366                       | 70635     | 29784            | 42  | 350    | 29581                | 99.32 | LBo3     | 2              | Transition       | Lake Bonney     | Taylor Valley |
| LB3_5.9  | 1                         | 26788     | 14393            | 54  | 350    | 14021                | 97.42 | LBo3     | 3              | Transition       | Lake Bonney     | Taylor Valley |
| LB3_7    | 15                        | 57730     | 24798            | 43  | 350    | 24159                | 97.42 | LBo3     | 4              | Dry              | Lake Bonney     | Taylor Valley |
| LB3_8    | 25                        | 82881     | 35679            | 43  | 350    | 34207                | 95.87 | LBo3     | 5              | Dry              | Lake Bonney     | Taylor Valley |
| LF1_0    | 1000                      | 78490     | 27712            | 35  | 350    | 26974                | 97.34 | LF1      | 1              | Wet              | Lake Fryxell    | Taylor Valley |
| LF1_1    | 1080                      | 70882     | 29129            | 41  | 350    | 28647                | 98.35 | LF1      | 2              | Transition       | Lake Fryxell    | Taylor Valley |
| LF1_19   | 996                       | 48830     | 23147            | 47  | 350    | 22714                | 98.13 | LF1      | 5              | Dry              | Lake Fryxell    | Taylor Valley |
| LF1_7    | 102                       | 71815     | 29989            | 42  | 350    | 29688                | 99.00 | LF1      | 3              | Transition       | Lake Fryxell    | Taylor Valley |
| LF1_8    | 400                       | 57759     | 23345            | 40  | 350    | 23005                | 98.54 | LF1      | 4              | Dry              | Lake Fryxell    | Taylor Valley |
| LF2_0    | 1140                      | 67334     | 25658            | 38  | 350    | 24617                | 95.94 | LF2      | 1              | Wet              | Lake Fryxell    | Taylor Valley |
| LF2_1    | 1200                      | 35663     | 16264            | 46  | 350    | 15627                | 96.08 | LF2      | 2              | Transition       | Lake Fryxell    | Taylor Valley |
| LF2_10   | 1120                      | 85438     | 31455            | 37  | 350    | 31267                | 99.40 | LF2      | 4              | Dry              | Lake Fryxell    | Taylor Valley |
| LF2_20.5 | 722                       | 54496     | 18718            | 34  | 350    | 18516                | 98.92 | LF2      | 5              | Dry              | Lake Fryxell    | Taylor Valley |
| LF2_9    | 23                        | 77692     | 28618            | 37  | 350    | 28406                | 99.26 | LF2      | 3              | Transition       | Lake Fryxell    | Taylor Valley |
| LF3_0    | 1160                      | 83743     | 31708            | 38  | 350    | 30424                | 95.95 | LF3      | 1              | Wet              | Lake Fryxell    | Taylor Valley |
| LF3_1    | 45                        | 62712     | 23181            | 37  | 350    | 22492                | 97.03 | LF3      | 2              | Transition       | Lake Fryxell    | Taylor Valley |
| LF3_20   | 684                       | 83802     | 31824            | 38  | 350    | 31228                | 98.13 | LF3      | 5              | Dry              | Lake Fryxell    | Taylor Valley |
| LF3_7    | 181                       | 55089     | 21624            | 39  | 350    | 21366                | 98.81 | LF3      | 3              | Transition       | Lake Fryxell    | Taylor Valley |
| LF3_8.5  | 836                       | 86817     | 34639            | 40  | 350    | 34105                | 98.46 | LF3      | 4              | Dry              | Lake Fryxell    | Taylor Valley |
| LH1_0    | 514                       | 73457     | 27980            | 38  | 350    | 26925                | 96.23 | LH1      | 1              | Wet              | Lake Hoare      | Taylor Valley |
| LH1_1    | 618                       | 76223     | 26387            | 35  | 350    | 25883                | 98.09 | LH1      | 2              | Transition       | Lake Hoare      | Taylor Valley |
| LH1_2    | 76.4                      | 20742     | 9738             | 47  | 350    | 9617                 | 98.76 | LH1      | 3              | Transition       | Lake Hoare      | Taylor Valley |
| LH1_2.5  | 133.4                     | 57758     | 22544            | 39  | 350    | 22286                | 98.86 | LH1      | 4              | Dry              | Lake Hoare      | Taylor Valley |
| LH1_7    | 926                       | 94313     | 34362            | 36  | 350    | 34033                | 99.04 | LH1      | 5              | Dry              | Lake Hoare      | Taylor Valley |
| LH2_0    | 876                       | 71305     | 27076            | 38  | 350    | 25982                | 95.96 | LH2      | 1              | Wet              | Lake Hoare      | Taylor Valley |
| LH2_1    | 682                       | 89187     | 33839            | 38  | 350    | 32736                | 96.74 | LH2      | 2              | Transition       | Lake Hoare      | Taylor Valley |
| LH2_3    | 86.4                      | 68540     | 22653            | 33  | 350    | 22273                | 98.32 | LH2      | 3              | Transition       | Lake Hoare      | Taylor Valley |
| LH2_3.5  | 182.2                     | 74620     | 26945            | 36  | 350    | 26645                | 98.89 | LH2      | 4              | Dry              | Lake Hoare      | Taylor Valley |
| LH2_7    | 524                       | 57092     | 18664            | 33  | 350    | 18431                | 98.75 | LH2      | 5              | Dry              | Lake Hoare      | Taylor Valley |
| Sp1_0    | 1040                      | 62267     | 18894            | 30  | 350    | 17158                | 90.81 | Sp1      | 1              | Wet              | Spaulding Pond  | Taylor Valley |
| Sp1_1.5  | 1080                      | 89714     | 34991            | 39  | 350    | 32404                | 92.61 | Sp1      | 2              | Transition       | Spaulding Pond  | Taylor Valley |
| Sp1_14   | 111                       | 68442     | 28012            | 41  | 350    | 27337                | 97.59 | Sp1      | 5              | Dry              | Spaulding Pond  | Taylor Valley |
| Sp1_3    | 824                       | 94708     | 40310            | 43  | 350    | 39262                | 97.40 | Sp1      | 3              | Transition       | Spaulding Pond  | Taylor Valley |
| Sp1_5    | 1060                      | 87065     | 37406            | 43  | 350    | 35910                | 96.00 | Sp1      | 4              | Dry              | Spaulding Pond  | Taylor Valley |
| Sp3_0    | 888                       | 137905    | 52784            | 38  | 350    | 46087                | 87.31 | Sp3      | 1              | Wet              | Spaulding Pond  | Taylor Valley |
| Sp3_1    | 822                       | 98758     | 36016            | 36  | 350    | 31029                | 86.15 | Sp3      | 2              | Transition       | Spaulding Pond  | Taylor Valley |
| Sp3_16   | 1000                      | 72169     | 28614            | 40  | 350    | 27871                | 97.40 | Sp3      | 5              | Dry              | Spaulding Pond  | Taylor Valley |
| Sp3_3    | 952                       | 92425     | 37294            | 40  | 350    | 35588                | 95.43 | Sp3      | 3              | Transition       | Spaulding Pond  | Taylor Valley |
| Sp3_6    | 640                       | 48311     | 20398            | 42  | 350    | 19830                | 97.22 | Sp3      | 4              | Dry              | Spaulding Pond  | Taylor Valley |
| Sp4_0    | 1020                      | 67494     | 24497            | 36  | 350    | 21489                | 87.72 | Sp4      | 1              | Wet              | Spaulding Pond  | Taylor Valley |
| Sp4_10   | 982                       | 88463     | 30574            | 35  | 350    | 29514                | 96.53 | Sp4      | 4              | Dry              | Spaulding Pond  | Taylor Valley |
| Sp4_14   | 990                       | 72375     | 25536            | 35  | 350    | 25093                | 98.27 | Sp4      | 5              | Dry              | Spaulding Pond  | Taylor Valley |
| Sp4_3    | 992                       | 78510     | 29776            | 38  | 350    | 27872                | 93.61 | Sp4      | 2              | Transition       | Spaulding Pond  | Taylor Valley |
| Sp4_5    | 950                       | 79454     | 28219            | 36  | 350    | 25979                | 92.06 | Sp4      | 3              | Transition       | Spaulding Pond  | Taylor Valley |
| VT4_1    | 19                        | 65763     | 17173            | 26  | 350    | 16892                | 98.36 | VT4      | 1              | Wet              | Lake Vanda      | Wright Valley |
| VT4_10   | 141                       | 59432     | 19335            | 33  | 350    | 19166                | 99.13 | VT4      | 5              | Dry              | Lake Vanda      | Wright Valley |
| VT4_2    | 17                        | 83147     | 29868            | 36  | 350    | 29434                | 98.55 | VT4      | 2              | Transition       | Lake Vanda      | Wright Valley |
| VT4_3.3  | 19                        | 80386     | 24525            | 31  | 350    | 24089                | 98.22 | VT4      | 3              | Transition       | Lake Vanda      | Wright Valley |
| VT4_4    | 31                        | 81458     | 21858            | 27  | 350    | 21660                | 99.09 | VT4      | 4              | Dry              | Lake Vanda      | Wright Valley |
| VT6_1    | 30                        | 65536     | 19713            | 30  | 350    | 19470                | 98.77 | VT6      | 1              | Wet              | Lake Vanda      | Wright Valley |
| VT6_2    | 17                        | 121604    | 57601            | 47  | 350    | 57262                | 99.41 | VT6      | 2              | Transition       | Lake Vanda      | Wright Valley |
| VT6_3.5  | 19                        | 39133     | 14230            | 36  | 350    | 13975                | 98.21 | VT6      | 3              | Transition       | Lake Vanda      | Wright Valley |
| VT6_4.5  | 31                        | 71480     | 23208            | 32  | 350    | 23132                | 99.67 | VT6      | 4              | Dry              | Lake Vanda      | Wright Valley |
| VT6_9    | 58                        | 293       | all filtered out | N/A | N/A    | N/A                  | N/A   | VT6      | 5              | Dry              | Lake Vanda      | Wright Valley |
| VT7_1    | 92                        | 50732     | 15103            | 30  | 350    | 14858                | 98.38 | VT7      | 1              | Wet              | Lake Vanda      | Wright Valley |
| VT7_12   | 40                        | 53999     | 17835            | 33  | 350    | 17669                | 99.07 | VT7      | 5              | Dry              | Lake Vanda      | Wright Valley |
| VT7_3    | 5                         | 72277     | 25442            | 35  | 350    | 25009                | 98.30 | VT7      | 2              | Transition       | Lake Vanda      | Wright Valley |
| VT7_4.5  | 27                        | 79156     | 25321            | 32  | 350    | 24945                | 98.52 | VT7      | 3              | Transition       | Lake Vanda      | Wright Valley |
| VT7_6    | 15                        | 51649     | 18937            | 37  | 350    | 18644                | 98.45 | VT7      | 4              | Dry              | Lake Vanda      | Wright Valley |

**Table S2** - Tukey multiple comparisons of means for beta-dispersion (betadisp) results between the three different zones for each lake transect.

| <b>Lake Fryxell</b>    |  | <b>p-value</b> |
|------------------------|--|----------------|
| Transition-Dry         |  | <0.01          |
| Wet-Dry                |  | 0.44           |
| Wet- Transition        |  | <0.001         |
| <b>Lake Bonney</b>     |  | <b>p-value</b> |
| Transition -Dry        |  | 0.02           |
| Wet-Dry                |  | 0.70           |
| Wet- Transition        |  | 0.01           |
| <b>Lake Hoare</b>      |  | <b>p-value</b> |
| Transition -Dry        |  | 0.11           |
| Wet-Dry                |  | 0.89           |
| Wet- Transition        |  | 0.36           |
| <b>Sapulding Pond</b>  |  | <b>p-value</b> |
| Transition -Dry        |  | 0.06           |
| Wet-Dry                |  | 0.43           |
| Wet- Transition        |  | 0.68           |
| <b>Lake Vanda</b>      |  | <b>p-value</b> |
| Transition -Dry        |  | <0.01          |
| Wet-Dry                |  | 0.74           |
| Wet- Transition        |  | <0.01          |
| <b>Lake Brownworth</b> |  | <b>p-value</b> |
| Transition -Dry        |  | 0.94           |
| Wet-Dry                |  | 0.57           |
| Wet- Transition        |  | 0.71           |

**Table S3** – Top twenty bacterial OTUs classified by Random Forest analysis as the most important to discriminate between the different zones of lake transects. The importance of OTUs is determined by the Mean Decrease in Accuracy from permuting the values in each feature. Mean Decrease in Accuracy contains a measure of the extent to which a variable improves the accuracy of the forest in predicting the classification.

| OTU ID  | Kingdom  | Phylum            | Class               | Order                | Family               | Genus             | Specie       |
|---------|----------|-------------------|---------------------|----------------------|----------------------|-------------------|--------------|
| OTU312  | Bacteria | Bacteroidota      | Bacteroidia         | Flavobacteriales     | Flavobacteriaceae    | Flavobacterium    | Unclassified |
| OTU6    | Bacteria | Bacteroidota      | Bacteroidia         | Chitinophagales      | Chitinophagaceae     | Segetibacter      | Unclassified |
| OTU40   | Bacteria | Bacteroidota      | Bacteroidia         | Chitinophagales      | Chitinophagaceae     | Ferruginibacter   | Unclassified |
| OTU93   | Bacteria | Verrucomicrobiota | Verrucomicrobia     | Verrucomicrobiales   | Rubritaleaceae       | Luteolibacter     | Unclassified |
| OTU150  | Bacteria | Chloroflexi       | Chloroflexia        | Kallotenuales        | AKIW781              | Unclassified      | Unclassified |
| OTU27   | Bacteria | Deinococcota      | Deinococci          | Deinococcales        | Trueperaceae         | Truepera          | Unclassified |
| OTU164  | Bacteria | Abditibacteriota  | Abditibacterii      | Abditibacteriales    | Abditibacteriaceae   | Abditibacterium   | Unclassified |
| OTU280  | Bacteria | Abditibacteriota  | Abditibacterii      | Abditibacteriales    | Abditibacteriaceae   | Abditibacterium   | Unclassified |
| OTU72   | Bacteria | Abditibacteriota  | Abditibacterii      | Abditibacteriales    | Abditibacteriaceae   | Abditibacterium   | Unclassified |
| OTU25   | Bacteria | Acidobacteriota   | Blastocatellia      | Blastocatellales     | Blastocatellaceae    | Blastocatella     | Unclassified |
| OTU9    | Bacteria | Acidobacteriota   | Blastocatellia      | Blastocatellales     | Blastocatellaceae    | Blastocatella     | Unclassified |
| OTU31   | Bacteria | Proteobacteria    | Gammaproteobacteria | Xanthomonadales      | Xanthomonadaceae     | Pseudoxanthomonas | Unclassified |
| OTU44   | Bacteria | Proteobacteria    | Gammaproteobacteria | Xanthomonadales      | Xanthomonadaceae     | Thermomonas       | Unclassified |
| OTU126  | Bacteria | Proteobacteria    | Alphaproteobacteria | Sphingomonadales     | Sphingomonadaceae    | Sphingorhabdus    | Unclassified |
| OTU33   | Bacteria | Proteobacteria    | Alphaproteobacteria | Sphingomonadales     | Sphingomonadaceae    | Sphingomonas      | Unclassified |
| OTU1839 | Bacteria | Proteobacteria    | Alphaproteobacteria | Caulobacteriales     | Caulobacteraceae     | Brevundimonas     | Unclassified |
| OTU73   | Bacteria | Actinobacteriota  | Rubrobacterii       | Rubrobacteriales     | Rubrobacteriaceae    | Rubrobacter       | Unclassified |
| OTU39   | Bacteria | Actinobacteriota  | Thermoleophilae     | Solirubrobacteriales | Solirubrobacteraceae | Unclassified      | Unclassified |
| OTU134  | Bacteria | Actinobacteriota  | Thermoleophilae     | Solirubrobacteriales | 67-14                | Unclassified      | Unclassified |
| OTU2208 | Bacteria | Actinobacteriota  | Actinobacterii      | Propionibacteriales  | Nocardoidaceae       | Marmoricola       | Unclassified |