Project_IRAS

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guides used: https://www.nicholas-ollberding.com/post/introduction-to-the-statistical-analysis-of-microbiome-data-in-r/, https://rpubs.com/lconteville/713954, https://mibwurrepo.github.io/Microbial-bioinformatics-introductory-course-Material-2018/beta-diversity-metrics.html, https://rfunctions.blogspot.com/2019/03/betadisper-and-adonis-homogeneity-of.html, https://david-barnett.github.io/microViz/articles/web-only/compositions.html, https://microbiome.github.io/OMA/viz-chapter.html, https://microbiome.github.io/OMA/clustering.html, https://microucph.github.io/amplicon_data_analysis/html/cluster.html, https://www.datacamp.com/tutorial/hierarchical-clustering-R, https://rpubs.com/TBrach/68544

```
library(phyloseq) # Data analysis and visualisation, also the basis of data object.
library(DT) # Interactive tables in html and markdown.
library(data.table) # Giving overview of data.
library(tidyverse) # Data handling and much more.
library(readxl) # Reading in excel files.
library(ape) # Phylogenetic package, used for creating random trees and as dependency for other packages
library(magrittr) # Data handling, specifically assignment pipes.
library(microViz) # Both analysis and visualisation.
library(plyr) # to apply functions, transform data.
library(microbiome) # For data analysis and visualisation, reading phyloseq object.
library(ggpubr) # Publication quality figures, based on ggplot2.
library(RColorBrewer) # Color options.
library(microbiomeutilities) # Some utility tools for microbiome package.
library(mia) # microbiome analysis package, making tse objects.
library(sechm) # Used for plotting heatmaps.
library(ggtree) # For creating trees, hierarchical clustering for heatmaps
library(pheatmap) # Creating heatmaps.
library(viridis) # Creating colour pallettes.
library(patchwork) # Used to add plots together into the same plot.
library(data.table) # Alternative to data.frame
library(picante) # Used for calculating Phylogenetic diversities
library(lme4) # Repeated measures, add to report if used
library(QsRutils) # For the goods() function, to estimate coverage
library(scater) # plotReducedDim
library(vegan) # used to run simper
library(nlme) # for usage of llply(), to apply functions over lists
library(mia) # Broad package, includes clustering functions.
library(bluster) # Used for clustering.
library(scater) # visualisation, reduced dimensions.
library(scran) # A wrapper for bluster and tse objects.
```

```r
library(NbClust) # To find out the optimal number of clusters.
library(dendextend) # For creating dendrograms with additional options, labeling etc.
library(factoextra) # Visualize optomial number of clusters.
library(cluster) # For clustering algorithms, specifically used for PAM.
```

Load packages

R Markdown

Metataxonomics

Loading in metataxonomic data

```r
pseq <- read_phyloseq(otu.file= "ASV.biom1",
                      taxonomy.file = NULL,
                      metadata.file = "MetaData.csv",
                      type="biom", sep =";" )

treefile <- read_tree("all_asvTREE.tree")
ps <-merge_phyloseq(pseq, treefile)
ps # 180 samples
```

```
## phyloseq-class experiment-level object
## otu_table()   OTU Table:         [ 6249 taxa and 180 samples ]
## sample_data() Sample Data:       [ 180 samples by 26 sample variables ]
## tax_table()   Taxonomy Table:    [ 6249 taxa by 6 taxonomic ranks ]
## phy_tree()    Phylogenetic Tree: [ 6249 tips and 6248 internal nodes ]
```

```r
sort(sample_sums(ps))
```

```
##        14.F2S1.20.06         4.F2S1.11.07        13.F2S2.11.07
##                46850                51537                56421
##         5.F2S2.20.06     8.F5.S2.CA.21.9.17        24.F2S1.11.07
##                57164                58212                59365
##   7.F4.S2.CA.8.8.2017        24.F2S2.20.06         7.F2S2.11.07
##                60691                64111                65002
##        26.F2S2.11.07        17.F2S1.11.07   2.F5.S1.CA.21.9.17
##                72476                73085                76540
## 9.F4.S2.CA.29.8.2017   4.F6.S2.CA.21.9.17         3.F2S2.11.07
##                77277                81063                82316
##   3.F6.S1.CA.21.9.17   3.F6.S2.CA.21.9.17        27.F1S2.31.08
##                85263                85370                85864
##         4.F1S1.21.09        34.F1S1.21.09   9.F5.S1.CA.21.9.17
##                86303                90167                94098
##        20.F1S1.31.08   2.F6.S2.CA.21.9.17   4.F6.S1.CA.21.9.17
##                94757                94800                95509
##   6.F4.S2.CA.8.8.2017        19.F2S2.11.07   7.F5.S1.CA.31.8.17
##                97472                99631               100430
##        28.F1S1.21.09   5.F5.S1.CA.21.9.17   1.F6.S1.CA.21.9.17
##               101299               104417               107531
```

```
##    3.F5.S1.CA.21.9.17        33.F1S2.21.09 7.F4.S1.CA.29.8.2017
##                107684               110305               115371
##         31.F1S2.31.08  9.F4.S2.CA.8.8.2017         3.F1S2.31.08
##                117379               117431               118155
##         35.F1S2.31.08   4.F5.S2.CA.31.8.17         1.F1S2.21.09
##                119253               119720               121074
##         18.F2S1.20.06 4.F4.S1.CA.29.8.2017        10.F2S1.20.06
##                121143               122331               123221
##         11.F1S2.21.09   6.F5.S1.CA.21.9.17        14.F1S1.21.09
##                123322               123520               126120
##   8.F4.S2.CA.8.8.2017        12.F1S1.21.09   6.F5.S2.CA.21.9.17
##                126501               128514               128935
##         25.F2S2.20.06         6.F1S1.21.09        10.F2S1.11.07
##                129532               130408               132808
## 8.F4.S1.CA.29.8.2017        14.F1S1.31.08         9.F2S2.20.06
##                135194               135303               135373
##         21.F1S2.31.08        15.F1S2.21.09 6.F4.S1.CA.29.8.2017
##                135703               135968               136635
##    8.F6.S1.CA.21.9.17 9.F4.S1.CA.29.8.2017  6.F4.S1.CA.8.8.2017
##                138151               138463               138738
##    4.F5.S1.CA.21.9.17  7.F4.S1.CA.8.8.2017   1.F5.S1.CA.21.9.17
##                140635               140868               142741
##         19.F2S2.20.06  1.F4.S1.CA.8.8.2017   1.F5.S2.CA.21.9.17
##                144528               146133               146908
##   5.F4.S1.CA.8.8.2017        25.F2S1.11.07   7.F5.S1.CA.21.9.17
##                148633               149461               150709
##    2.F6.S1.CA.21.9.17   2.F5.S2.CA.21.9.17  8.F4.S1.CA.8.8.2017
##                150730               151425               153407
## 8.F4.S2.CA.29.8.2017 6.F4.S2.CA.29.8.2017         2.F2S2.20.06
##                153433               153692               153925
##          7.F1S2.21.09   2.F5.S2.CA.31.8.17        19.F1S2.21.09
##                155378               156224               156652
## 1.F4.S1.CA.29.8.2017         2.F1S1.31.08        18.F2S2.11.07
##                157292               158039               158392
## 2.F4.S2.CA.29.8.2017        30.F1S1.21.09         4.F2S2.11.07
##                158954               160633               160749
##    3.F5.S1.CA.31.8.17   8.F5.S1.CA.21.9.17        21.F1S2.21.09
##                161067               163383               163995
##    4.F5.S2.CA.21.9.17   5.F6.S1.CA.21.9.17   8.F6.S1.CA.31.8.17
##                166497               166953               167207
##   5.F4.S2.CA.8.8.2017        22.F1S1.21.09   9.F5.S2.CA.21.9.17
##                167899               169419               170464
##         13.F2S1.11.07   1.F6.S2.CA.21.9.17 5.F4.S1.CA.29.8.2017
##                171477               173496               173499
##          9.F1S2.31.08 3.F4.S2.CA.29.8.2017        20.F2S1.11.07
##                173638               175652               175734
##          6.F1S1.31.08         9.F2S1.11.07        10.F1S1.31.08
##                176305               178651               178746
##         10.F2S2.11.07 3.F4.S1.CA.29.8.2017   5.F5.S2.CA.21.9.17
##                179318               180443               180662
##          8.F2S1.20.06  2.F4.S1.CA.8.8.2017        25.F2S1.20.06
##                182277               188508               189251
##         17.F2S2.20.06   1.F5.S2.CA.31.8.17  9.F4.S1.CA.8.8.2017
##                189516               189756               192242
```

```
##         1.F2S1.11.07 1.F4.S2.CA.29.8.2017  4.F4.S2.CA.8.8.2017
##               192332               192909               194069
##     3.F5.S2.CA.21.9.17          2.F2S1.20.06  3.F4.S2.CA.8.8.2017
##               194734               195641               199046
##     7.F5.S2.CA.21.9.17   7.F5.S2.CA.31.8.17  2.F4.S2.CA.8.8.2017
##               199400               199807               201158
##        22.F1S1.31.08 5.F4.S2.CA.29.8.2017 2.F4.S1.CA.29.8.2017
##               201793               203638               204571
##        34.F1S1.31.08          5.F1S2.31.08 7.F4.S2.CA.29.8.2017
##               204694               207273               209008
##     1.F6.S2.CA.31.8.17   9.F6.S2.CA.31.8.17   3.F6.S2.CA.31.8.17
##               209323               221264               221983
##   1.F4.S2.CA.8.8.2017        22.F2S2.11.07   3.F5.S2.CA.31.8.17
##               221999               226798               228397
##     5.F5.S1.CA.31.8.17        20.F1S1.21.09   3.F6.S1.CA.31.8.17
##               228481               230243               231433
##     2.F6.S1.CA.31.8.17        13.F1S2.31.08        19.F1S2.31.08
##               232543               233573               235914
##     8.F5.S1.CA.31.8.17        27.F1S2.21.09   6.F6.S2.CA.31.8.17
##               239846               242410               244741
##   3.F4.S1.CA.8.8.2017   9.F6.S1.CA.21.9.17   5.F6.S1.CA.31.8.17
##               246719               247130               248915
##     6.F5.S1.CA.31.8.17        32.F1S1.31.08   2.F5.S1.CA.31.8.17
##               249576               249739               251208
##   4.F4.S1.CA.8.8.2017        22.F2S1.20.06   9.F6.S1.CA.31.8.17
##               251679               251715               257402
##     5.F5.S2.CA.31.8.17   6.F6.S1.CA.21.9.17   9.F5.S2.CA.31.8.17
##               257528               258237               259497
##     6.F5.S2.CA.31.8.17        31.F1S2.21.09   7.F6.S2.CA.31.8.17
##               260095               260175               261493
##     4.F6.S1.CA.31.8.17   4.F5.S1.CA.31.8.17   7.F6.S2.CA.21.9.17
##               263338               264570               269513
##     7.F6.S1.CA.21.9.17   9.F5.S1.CA.31.8.17   8.F5.S2.CA.31.8.17
##               269892               277381               278536
##     8.F6.S2.CA.21.9.17   6.F6.S1.CA.31.8.17        12.F2S2.20.06
##               279210               281640               282992
##     1.F6.S1.CA.31.8.17   8.F6.S2.CA.31.8.17        14.F2S2.20.06
##               283033               283726               289533
##     4.F6.S2.CA.31.8.17         4.F2S1.20.06 4.F4.S2.CA.29.8.2017
##               296588               297958               303543
##     1.F5.S1.CA.31.8.17        28.F1S1.31.08   7.F6.S1.CA.31.8.17
##               304766               305042               307360
##        19.F2S1.20.06   9.F6.S2.CA.21.9.17   5.F6.S2.CA.31.8.17
##               308959               320077               338720
##     2.F6.S2.CA.31.8.17   5.F6.S2.CA.21.9.17   6.F6.S2.CA.21.9.17
##               368702               393697               395258
```

```
### overview data
datatable(tax_table(ps))
```

```
### remove some contamination to filter out plant and eukaryote data that had chloroplast and mitochondi
subset <- subset_taxa(ps, Domain !="NA")
subset <- subset_taxa(subset,Family !="f__Mitochondria=*")
subset <- subset_taxa(subset,Family !="f__Mitochondria")
```

```r
subset <- subset_taxa(subset, Order !="o__Chloroplast")
subset <- subset_taxa(subset, Domain!="k__Archaea")

### remove taxa with zeros
subset <- prune_taxa(taxa_sums(subset) > 0, subset)

### subset phyloseq object n=120 metagenomics data
subset16S  <- subset_samples(subset,  Metagenomics == "yes" )    #n=120
subset16S <- prune_taxa(taxa_sums(subset16S) > 0, subset16S)
subset16S # 120 samples
```

```
## phyloseq-class experiment-level object
## otu_table()   OTU Table:         [ 1536 taxa and 120 samples ]
## sample_data() Sample Data:       [ 120 samples by 26 sample variables ]
## tax_table()   Taxonomy Table:    [ 1536 taxa by 6 taxonomic ranks ]
## phy_tree()    Phylogenetic Tree: [ 1536 tips and 1535 internal nodes ]
```

```r
# cleaning out all kinds of overlapping names from taxonomy table, removing ~*, =* and =<empty>, this h
subset16S@tax_table = gsub("=\\*|~\\*|\\*|<empty>","",subset16S@tax_table)

# overview data
datatable(tax_table(subset16S))
```

```r
rank_names(subset16S) # Shows classes and ARGs
```

```
## [1] "Domain" "Phylum" "Class"  "Order"  "Family" "Genus"
```

```r
sort(get_taxa_unique(subset16S, "Genus")) # Shows unique genera
```

```
##  [1] "g__"
##  [2] "g__[Eubacterium]_coprostanoligenes_group"
##  [3] "g__[Eubacterium]_hallii_group"
##  [4] "g__[Eubacterium]_nodatum_group"
##  [5] "g__[Eubacterium]_ventriosum_group"
##  [6] "g__[Ruminococcus]_gauvreauii_group"
##  [7] "g__[Ruminococcus]_torques_group"
##  [8] "g__Akkermansia"
##  [9] "g__Alistipes"
## [10] "g__Anaerofilum"
## [11] "g__Anaerofustis"
## [12] "g__Anaeroplasma"
## [13] "g__Anaerostipes"
## [14] "g__Anaerotruncus"
## [15] "g__Angelakisella"
## [16] "g__ASF356"
## [17] "g__Bacillus"
## [18] "g__Bacteroides"
## [19] "g__Bifidobacterium"
## [20] "g__Bilophila"
## [21] "g__Blautia"
## [22] "g__Brachybacterium"
```

```
## [23] "g__Butyricicoccus"
## [24] "g__Caldalkalibacillus"
## [25] "g__Candidatus_Soleaferrea"
## [26] "g__CHKCI001"
## [27] "g__CHKCI002"
## [28] "g__Christensenellaceae_R-7_group"
## [29] "g__Coprobacter"
## [30] "g__Coprococcus_3"
## [31] "g__Corynebacterium_1"
## [32] "g__Defluviitaleaceae_UCG-011"
## [33] "g__Dielma"
## [34] "g__DTU089"
## [35] "g__Eisenbergiella"
## [36] "g__Enterococcus"
## [37] "g__Erysipelatoclostridium"
## [38] "g__Escherichia-Shigella"
## [39] "g__Faecalibacterium"
## [40] "g__Family_XIII_AD3011_group"
## [41] "g__Flavonifractor"
## [42] "g__Fournierella"
## [43] "g__Fusicatenibacter"
## [44] "g__GCA-900066225"
## [45] "g__GCA-900066575"
## [46] "g__Gordonibacter"
## [47] "g__Hydrogenoanaerobacterium"
## [48] "g__Intestinimonas"
## [49] "g__Lachnoclostridium"
## [50] "g__Lachnospiraceae_FCS020_group"
## [51] "g__Lachnospiraceae_FE2018_group"
## [52] "g__Lachnospiraceae_UCG-004"
## [53] "g__Lachnospiraceae_UCG-006"
## [54] "g__Lachnospiraceae_UCG-008"
## [55] "g__Lactobacillus"
## [56] "g__Marvinbryantia"
## [57] "g__Merdibacter"
## [58] "g__Negativibacillus"
## [59] "g__Odoribacter"
## [60] "g__Oscillibacter"
## [61] "g__Oscillospira"
## [62] "g__Parabacteroides"
## [63] "g__Paraeggerthella"
## [64] "g__Parasutterella"
## [65] "g__Phascolarctobacterium"
## [66] "g__Phocea"
## [67] "g__Ralstonia"
## [68] "g__Romboutsia"
## [69] "g__Roseburia"
## [70] "g__Ruminiclostridium"
## [71] "g__Ruminiclostridium_5"
## [72] "g__Ruminiclostridium_9"
## [73] "g__Ruminococcaceae_NK4A214_group"
## [74] "g__Ruminococcaceae_UCG-005"
## [75] "g__Ruminococcaceae_UCG-009"
## [76] "g__Ruminococcaceae_UCG-010"
```

```
## [77] "g__Ruminococcaceae_UCG-013"
## [78] "g__Ruminococcaceae_UCG-014"
## [79] "g__Ruminococcus_1"
## [80] "g__Ruminococcus_2"
## [81] "g__Sellimonas"
## [82] "g__Shuttleworthia"
## [83] "g__Staphylococcus"
## [84] "g__Streptococcus"
## [85] "g__Subdoligranulum"
## [86] "g__Tyzzerella"
## [87] "g__Tyzzerella_3"
## [88] "g__UBA1819"
## [89] "g__UC5-1-2E3"
## [90] "g__uncultured"
## [91] "g__uncultured_bacterium"
## [92] "g__uncultured_organism"
## [93] "g__Weissella"
```

```
sort(sample_sums(subset16S)) # Amount of unique taxa"per sample, the min is 46731 and max 393697, which
```

```
##        14.F2S1.20.06         4.F2S1.11.07        13.F2S2.11.07
##                46731                51537                55002
##         5.F2S2.20.06        24.F2S1.11.07         7.F2S2.11.07
##                57164                59138                65002
##   2.F5.S1.CA.21.9.17   4.F6.S2.CA.21.9.17   3.F6.S1.CA.21.9.17
##                76540                80838                85041
##   3.F6.S2.CA.21.9.17        27.F1S2.31.08         4.F1S1.21.09
##                85370                85751                86303
##        20.F1S1.31.08   2.F6.S2.CA.21.9.17   4.F6.S1.CA.21.9.17
##                94222                94800                95509
##   6.F4.S2.CA.8.8.2017        19.F2S2.11.07   7.F5.S1.CA.31.8.17
##                96497                99631               100277
##   5.F5.S1.CA.21.9.17   1.F6.S1.CA.21.9.17   3.F5.S1.CA.21.9.17
##               104268               107531               107684
##        10.F2S1.20.06        31.F1S2.31.08        35.F1S2.31.08
##               112768               117379               119253
##   4.F5.S2.CA.31.8.17        18.F2S1.20.06         1.F1S2.21.09
##               119720               120688               121074
## 4.F4.S1.CA.29.8.2017   6.F5.S1.CA.21.9.17        11.F1S2.21.09
##               121879               123314               123322
##        14.F1S1.21.09        12.F1S1.21.09   6.F5.S2.CA.21.9.17
##               126120               128514               128935
##         6.F1S1.21.09        10.F2S1.11.07 8.F4.S1.CA.29.8.2017
##               130408               132808               134681
##         9.F2S2.20.06        14.F1S1.31.08        21.F1S2.31.08
##               134990               135080               135703
##        15.F1S2.21.09 6.F4.S1.CA.29.8.2017   8.F6.S1.CA.21.9.17
##               135968               136635               137890
##   6.F4.S1.CA.8.8.2017   4.F5.S1.CA.21.9.17   7.F4.S1.CA.8.8.2017
##               138088               140635               140868
##   1.F5.S1.CA.21.9.17   1.F4.S1.CA.8.8.2017   1.F5.S2.CA.21.9.17
##               141444               146133               146908
##   2.F6.S1.CA.21.9.17   2.F5.S2.CA.21.9.17         7.F1S2.21.09
##               150121               151425               153367
```

```
## 6.F4.S2.CA.29.8.2017         2.F2S2.20.06   2.F5.S2.CA.31.8.17
##                153497               153925               155053
##        19.F1S2.21.09 1.F4.S1.CA.29.8.2017         2.F1S1.31.08
##                156652               157292               158039
##        18.F2S2.11.07 2.F4.S2.CA.29.8.2017   3.F5.S1.CA.31.8.17
##                158392               158632               159579
##        21.F1S2.21.09   4.F5.S2.CA.21.9.17   8.F6.S1.CA.31.8.17
##                163719               165742               166565
##  5.F4.S2.CA.8.8.2017        22.F1S1.21.09        20.F2S1.11.07
##                167240               169419               171242
##   1.F6.S2.CA.21.9.17         9.F1S2.31.08 3.F4.S2.CA.29.8.2017
##                173063               173638               175120
##         6.F1S1.31.08         9.F2S1.11.07        10.F1S1.31.08
##                175950               177762               178746
## 3.F4.S1.CA.29.8.2017        10.F2S2.11.07   5.F5.S2.CA.21.9.17
##                179206               179318               180662
##         8.F2S1.20.06  2.F4.S1.CA.8.8.2017   1.F5.S2.CA.31.8.17
##                182277               188508               189411
##        17.F2S2.20.06         1.F2S1.11.07 1.F4.S2.CA.29.8.2017
##                189516               191885               192096
##  4.F4.S2.CA.8.8.2017   3.F5.S2.CA.21.9.17         2.F2S1.20.06
##                194069               194327               194902
##  3.F4.S2.CA.8.8.2017  2.F4.S2.CA.8.8.2017 5.F4.S2.CA.29.8.2017
##                199046               201158               203364
## 2.F4.S1.CA.29.8.2017         5.F1S2.31.08   1.F6.S2.CA.31.8.17
##                203912               207273               209323
##   3.F6.S2.CA.31.8.17  1.F4.S2.CA.8.8.2017        22.F2S2.11.07
##                221983               221999               225672
##   3.F5.S2.CA.31.8.17        20.F1S1.21.09   3.F6.S1.CA.31.8.17
##                227443               230243               231433
##   2.F6.S1.CA.31.8.17   8.F5.S1.CA.31.8.17   6.F6.S2.CA.31.8.17
##                232543               238256               244741
##  3.F4.S1.CA.8.8.2017   2.F5.S1.CA.31.8.17  4.F4.S1.CA.8.8.2017
##                246719               250484               251679
##   5.F5.S2.CA.31.8.17   6.F5.S2.CA.31.8.17   4.F6.S1.CA.31.8.17
##                257528               260095               263338
##   4.F5.S1.CA.31.8.17   7.F6.S1.CA.21.9.17   7.F6.S2.CA.21.9.17
##                264570               269468               269513
##        12.F2S2.20.06   1.F6.S1.CA.31.8.17        14.F2S2.20.06
##                282992               283033               289533
##   4.F6.S2.CA.31.8.17         4.F2S1.20.06 4.F4.S2.CA.29.8.2017
##                296588               297958               303543
##        28.F1S1.31.08   1.F5.S1.CA.31.8.17   7.F6.S1.CA.31.8.17
##                304246               304446               307360
##   5.F6.S2.CA.31.8.17   2.F6.S2.CA.31.8.17   5.F6.S2.CA.21.9.17
##                338720               368702               393697
```

```
summary(sample_sums(subset16S)) # summary of the sampling depths
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   46731  125421  161649  173742  212488  393697
```

```r
sample_variables(subset16S) # metadata variables
```

```
##  [1] "LibraryNumber"   "Sample_Unique"   "LibraryName"     "Farm"
##  [5] "Farm2"           "Stable"          "FarmRoundStable" "Days"
##  [9] "Age"             "Sname"           "WeightAnimal"    "Gender"
## [13] "AgeParentStock"  "Hatchery"        "Researcher"      "AB"
## [17] "Abday"           "FlockSize"       "FeedF"           "FeedType"
## [21] "FeedProducent"   "Cox"             "OPG"             "Cluster"
## [25] "LitterType"      "Metagenomics"
```

```r
# Rewriting sampleIDs as sample_unique rownames to align with the other datasets

sample_names(subset16S) = sample_data(subset16S)$Sample_Unique
sample_names(subset16S)
```

```
##   [1] "2_23"  "2_24"  "2_25"  "2_26"  "2_27"  "2_29"  "2_36"  "2_39"  "2_40"
##  [10] "2_41"  "2_42"  "2_47"  "2_48"  "2_49"  "2_50"  "2_51"  "2_52"  "2_56"
##  [19] "2_57"  "2_58"  "2_59"  "2_60"  "2_61"  "4_36"  "4_37"  "4_38"  "4_39"
##  [28] "4_40"  "4_41"  "4_54"  "4_55"  "4_56"  "4_57"  "4_65"  "5_39"  "5_40"
##  [37] "5_41"  "5_54"  "5_55"  "5_59"  "6_36"  "6_37"  "6_38"  "6_54"  "6_55"
##  [46] "6_56"  "6_57"  "6_58"  "9_16"  "9_17"  "9_18"  "9_19"  "9_21"  "9_22"
##  [55] "9_34"  "9_35"  "9_36"  "9_37"  "9_38"  "9_39"  "10_1"  "10_2"  "10_3"
##  [64] "10_4"  "10_7"  "10_8"  "10_10" "10_11" "10_12" "10_13" "10_14" "10_15"
##  [73] "10_19" "10_20" "10_21" "10_22" "10_25" "10_26" "10_28" "10_29" "10_30"
##  [82] "10_33" "10_34" "10_35" "10_39" "10_40" "10_41" "10_42" "10_43" "10_44"
##  [91] "10_48" "10_49" "10_50" "10_51" "10_52" "10_53" "10_57" "10_58" "10_59"
## [100] "10_60" "10_63" "10_64" "10_66" "10_67" "10_68" "10_69" "11_1"  "11_3"
## [109] "14_20" "14_21" "14_22" "14_23" "14_25" "14_27" "14_29" "14_30" "14_33"
## [118] "14_34" "14_35" "14_36"
```

```r
# Stable "Farm2R1S1"  has the three lowest sampling depths of the dataset, the other nine samples are f
subset16S %>% ps_filter(FarmRoundStable == c("Farm2R1S1")) %>% sample_sums() %>% sort()
```

```
##   4_40   4_55   5_55   4_39   4_41   4_57   5_54   4_56   4_38   4_54   4_36
##  46731  51537  59138 112768 120688 132808 171242 177762 182277 191885 194902
##   4_37
## 297958
```

```r
# Amount of different taxa present.
sort(table(tax_table(subset16S)[, "Phylum"]))
```

```
##
## p__Verrucomicrobia   p__Cyanobacteria  p__Proteobacteria   p__Bacteroidetes
##                  2                 13                 14                 22
##  p__Actinobacteria     p__Tenericutes      p__Firmicutes
##                 48                 81               1356
```

```r
sort(table(tax_table(subset16S)[, "Order"]))
```

```
##
```

```
##       o__Selenomonadales     o__Corynebacteriales    o__Desulfovibrionales
##                       1                        2                        2
##      o__Izimaplasmatales         o__Micrococcales    o__Verrucomicrobiales
##                       2                        2                        2
##                     o__     o__Anaeroplasmatales     o__Enterobacteriales
##                       4                        4                        5
##           o__Bacillales o__Betaproteobacteriales      o__Coriobacteriales
##                       6                        7                       12
##   o__Gastranaerophilales         o__Bacteroidales     o__Bifidobacteriales
##                      13                       22                       32
##    o__Erysipelotrichales       o__Lactobacillales        o__Mollicutes_RF39
##                      39                       45                       71
##         o__Clostridiales
##                    1265
```

```r
sort(table(tax_table(subset16S)[, "Family"]))
```

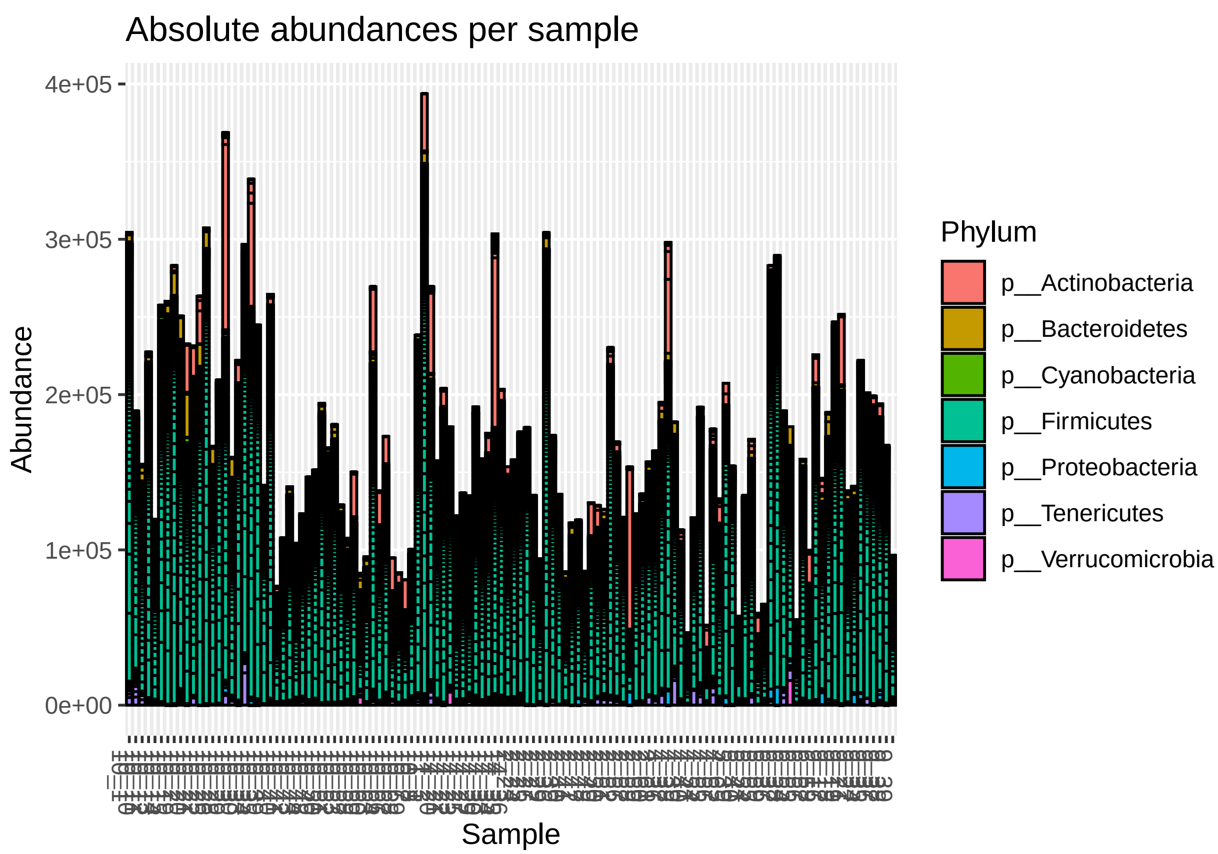
```
##
##                f__Acidaminococcaceae                     f__Barnesiellaceae
##                                    1                                      1
##                  f__Dermabacteraceae                      f__Eubacteriaceae
##                                    1                                      1
##                               f__F082                  f__Gracilibacteraceae
##                                    1                                      1
##                  f__Leuconostocaceae                      f__Marinifilaceae
##                                    1                                      1
##                    f__Micrococcaceae                     f__Akkermansiaceae
##                                    1                                      2
##                f__Corynebacteriaceae                 f__Desulfovibrionaceae
##                                    2                                      2
##                    f__Peptococcaceae                   f__Streptococcaceae
##                                    2                                      2
## f__uncultured_Firmicutes_bacterium                          f__Bacillaceae
##                                    2                                      3
##                     f__Rikenellaceae                  f__Staphylococcaceae
##                                    3                                      3
##                   f__Tannerellaceae        f__uncultured_rumen_bacterium
##                                    3                                      3
##               f__Anaeroplasmataceae                  f__Defluviitaleaceae
##                                    4                                      4
##                      f__Family_XIII                 f__Enterobacteriaceae
##                                    4                                      5
##                  f__Enterococcaceae                   f__Burkholderiaceae
##                                    5                                      7
##            f__Peptostreptococcaceae                    f__Eggerthellaceae
##                                   11                                     12
##                   f__Bacteroidaceae                 f__Christensenellaceae
##                                   13                                     24
##    f__Clostridiales_vadinBB60_group                  f__Bifidobacteriaceae
##                                   28                                     32
##                                  f__                   f__Lactobacillaceae
##                                   33                                     37
##              f__Erysipelotrichaceae                f__uncultured_bacterium
##                                   39                                     62
```

```
##               f__Ruminococcaceae                f__Lachnospiraceae
##                              549                               631
```

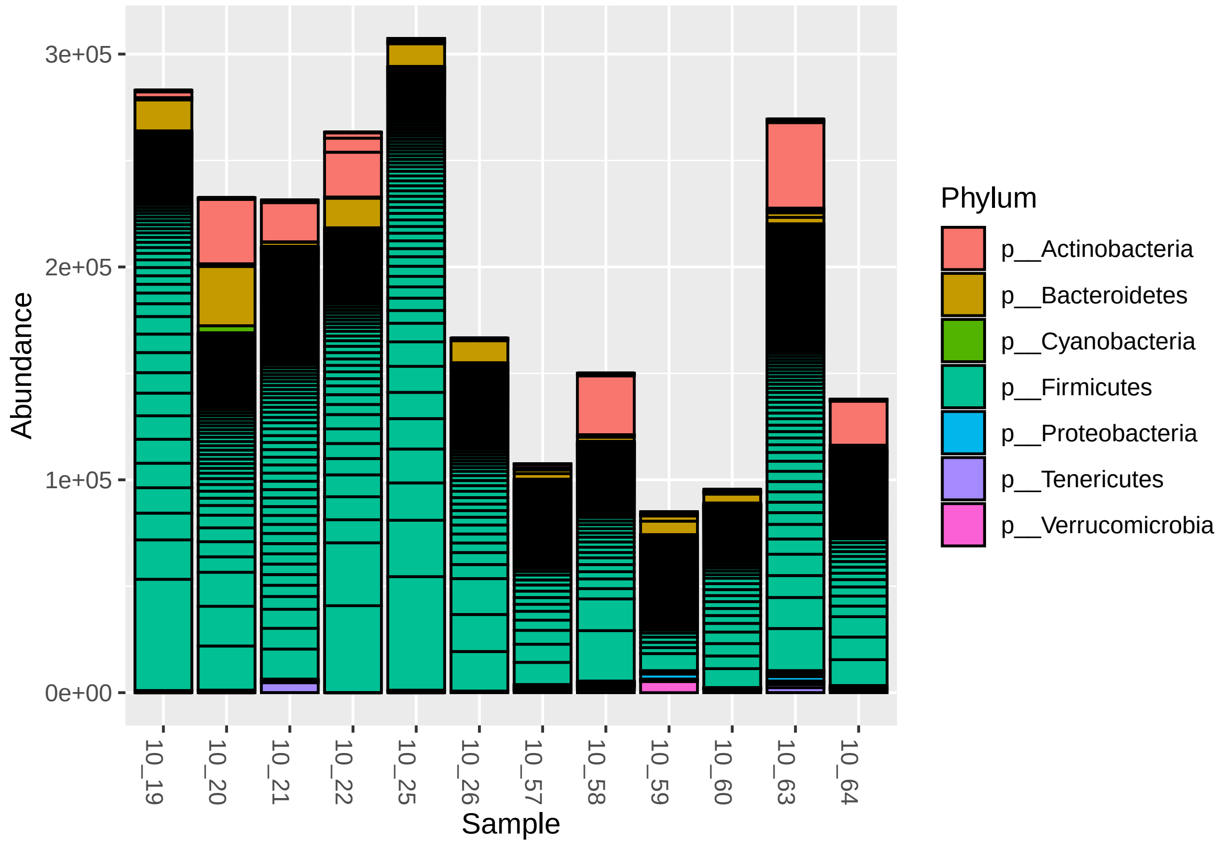
```
# factorizing variables as not to create problems with visualization later down the line
sample_data(subset16S)$Cluster = as.factor(sample_data(subset16S)$Cluster)
sample_data(subset16S)$FlockSize = as.factor(sample_data(subset16S)$FlockSize)
sample_data(subset16S)$AgeParentStock = as.factor(sample_data(subset16S)$AgeParentStock)
sample_data(subset16S)$Age = as.factor(sample_data(subset16S)$Age)
sample_data(subset16S)$LibraryNumber = as.factor(sample_data(subset16S)$LibraryNumber)

# add stable column with shorter names
sample_data(subset16S)$FarmRoundStable = as.factor(sample_data(subset16S)$FarmRoundStable)
subset16S@sam_data$Stables = revalue(sample_data(subset16S)$FarmRoundStable, c("Farm1R1S1"="Stable1", "F
                                                                              "Farm2R2S1"="Stable5", "Fa
                                                                              "Farm4R1S1"="Stable9", "Fa
# Shortening agent names
subset16S@sam_data$Cox[subset16S@sam_data$Cox == "narasinandnicarbazin(maxiban)"] = "Maxiban"
subset16S@sam_data$Cox[subset16S@sam_data$Cox == "narasin(monteban)"] = "Monteban"
subset16S@sam_data$Cox[subset16S@sam_data$Cox == "salinomycin(Sacox120microGranulate)"] = "Sacox"
```

Abundances and heatmaps

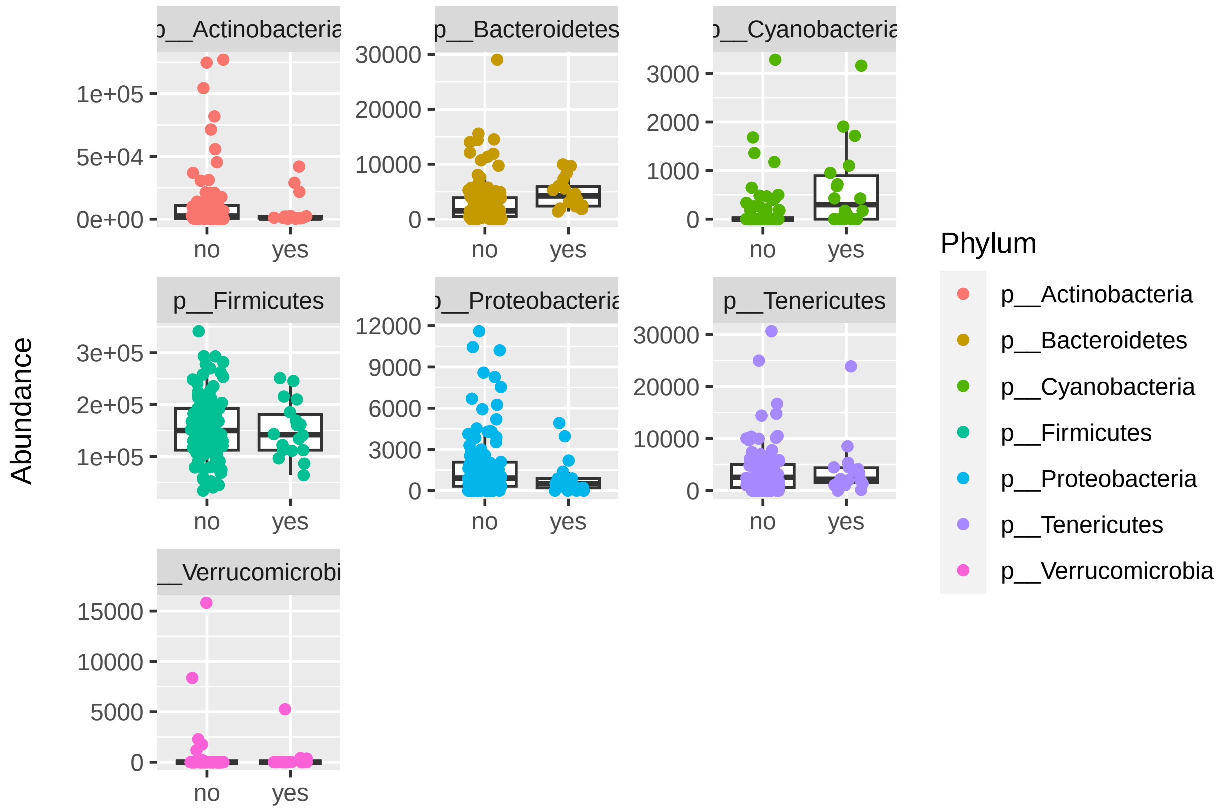
```
# absolute abundances - phylum
plot_bar(subset16S, fill="Phylum", title = "Absolute abundances per sample")
```



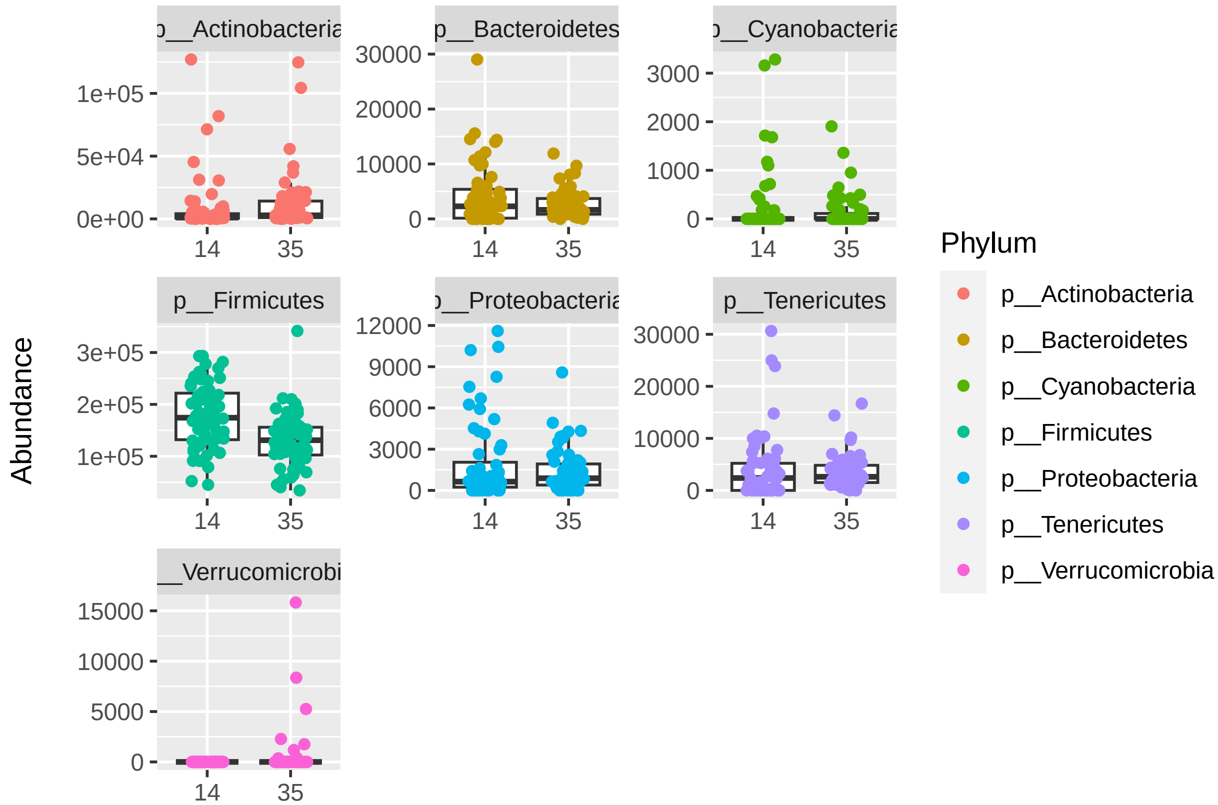
```r
# for plotting abundances of specific stables
subset16S %>% ps_filter(Stables == c("Stable9")) %>% plot_bar(fill="Phylum")
```



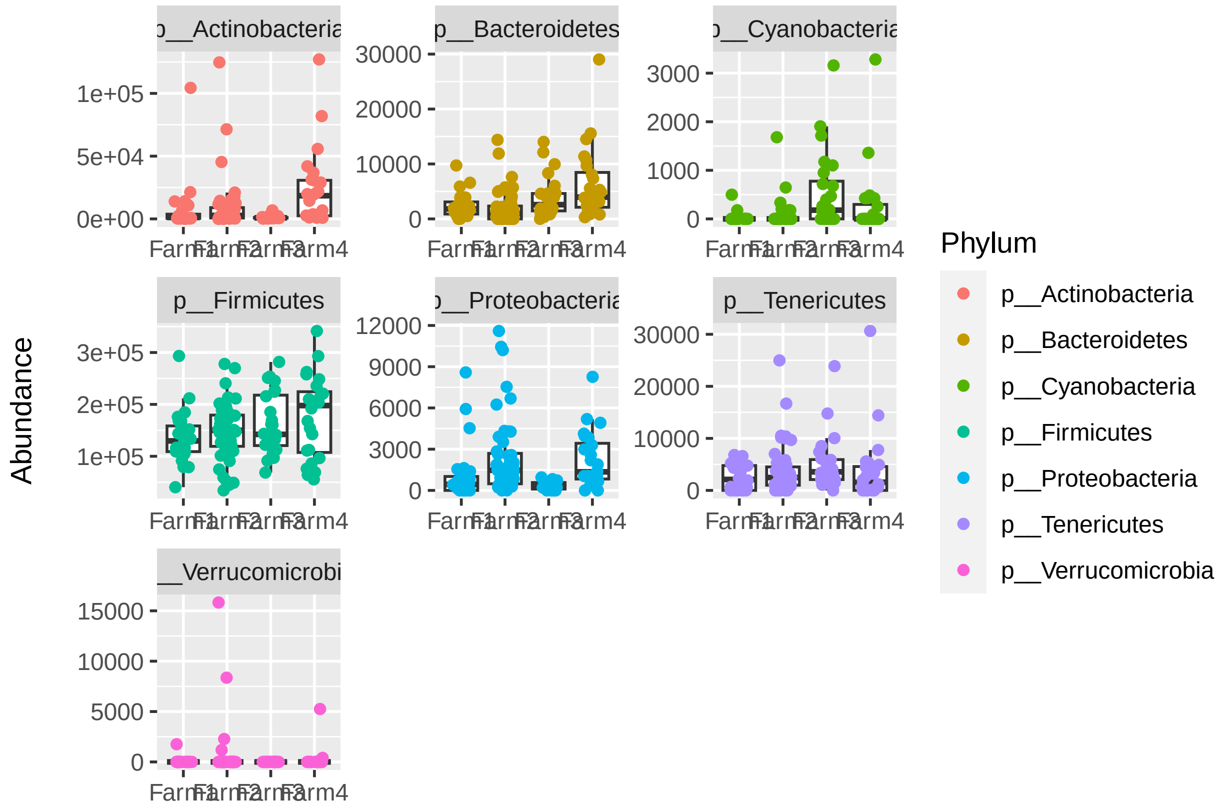

```r
# visualisation on AB at Phylum level, more data for samples which have not been treated with AB, but a

ps_prim <- phyloseq::tax_glom(subset16S, "Phylum")
taxa_names(ps_prim) <- phyloseq::tax_table(ps_prim)[, "Phylum"]

psmelt(ps_prim) %>% # AB
  ggplot(data = ., aes(x = AB, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Phylum), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Phylum, scales = "free")
```



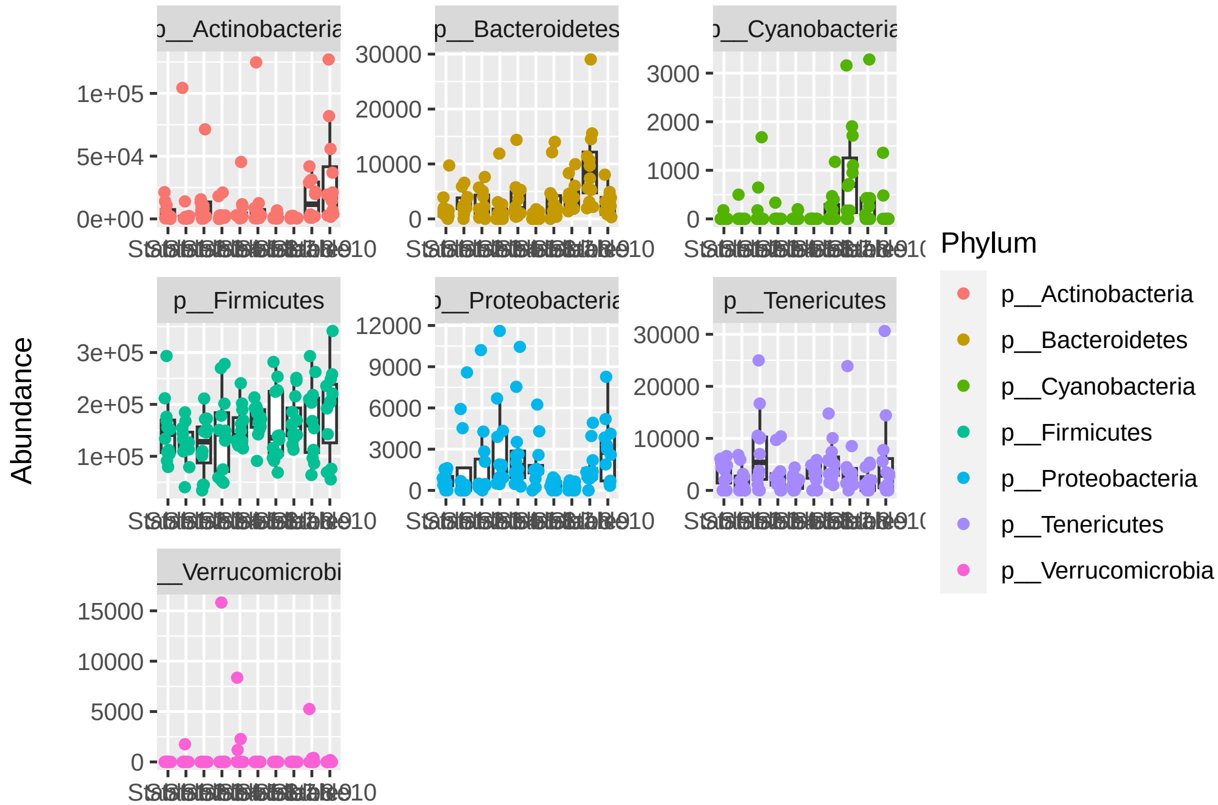

```
psmelt(ps_prim) %>% # Age
  ggplot(data = ., aes(x = Age, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Phylum), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Phylum, scales = "free")
```



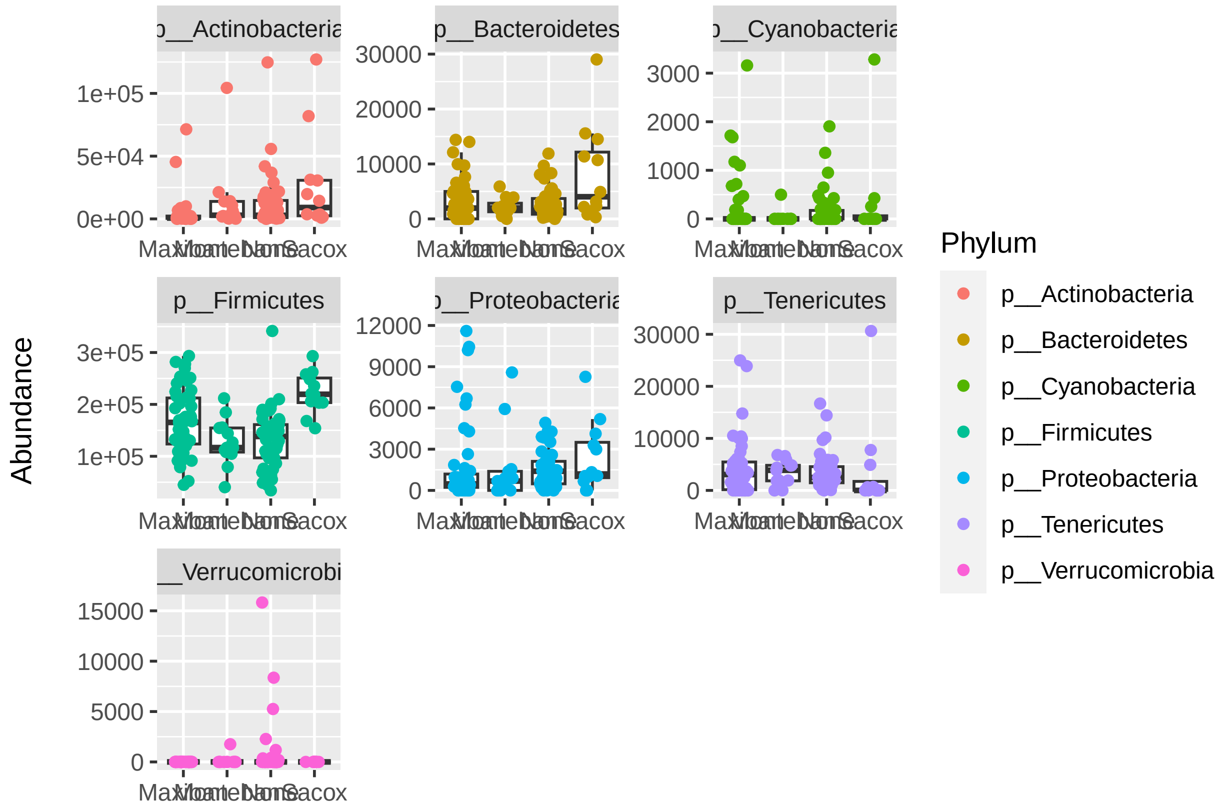

```
psmelt(ps_prim) %>% # Farm
  ggplot(data = ., aes(x = Farm2, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Phylum), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Phylum, scales = "free")
```



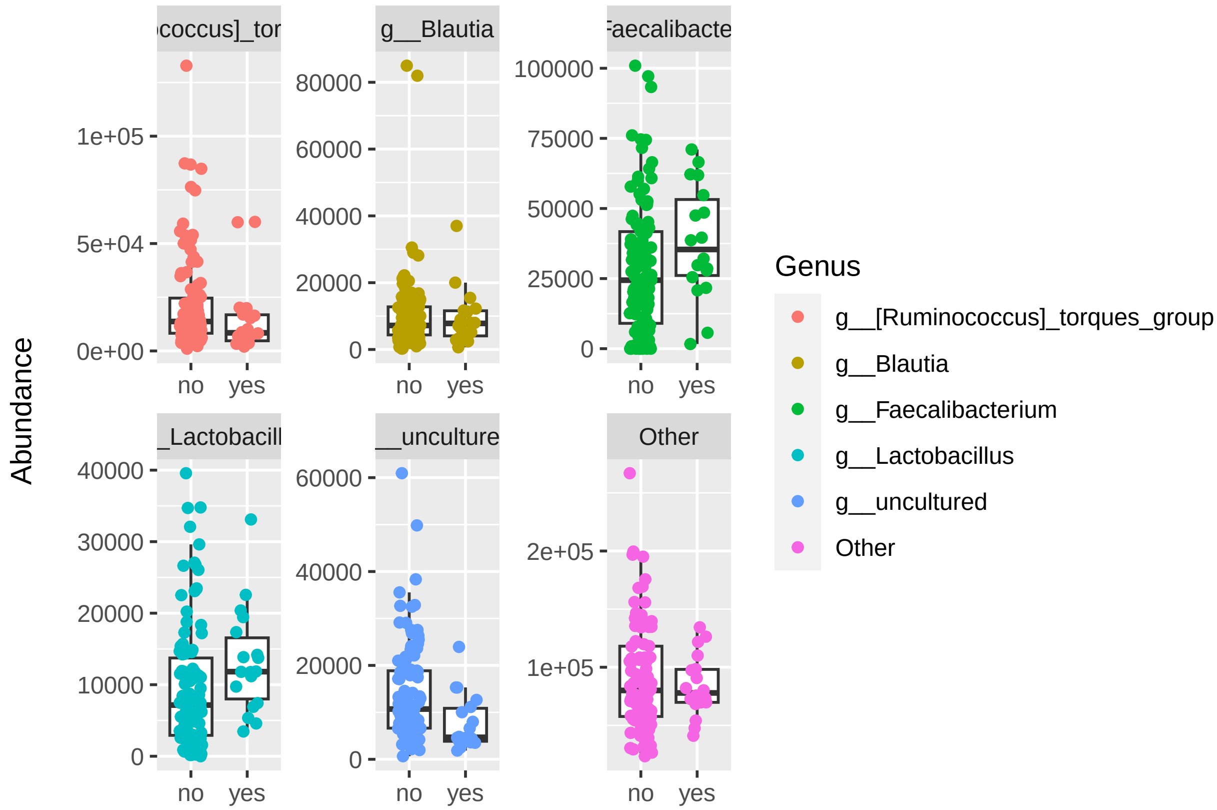

```r
psmelt(ps_prim) %>% # Stable
  ggplot(data = ., aes(x = Stables, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Phylum), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Phylum, scales = "free")
```



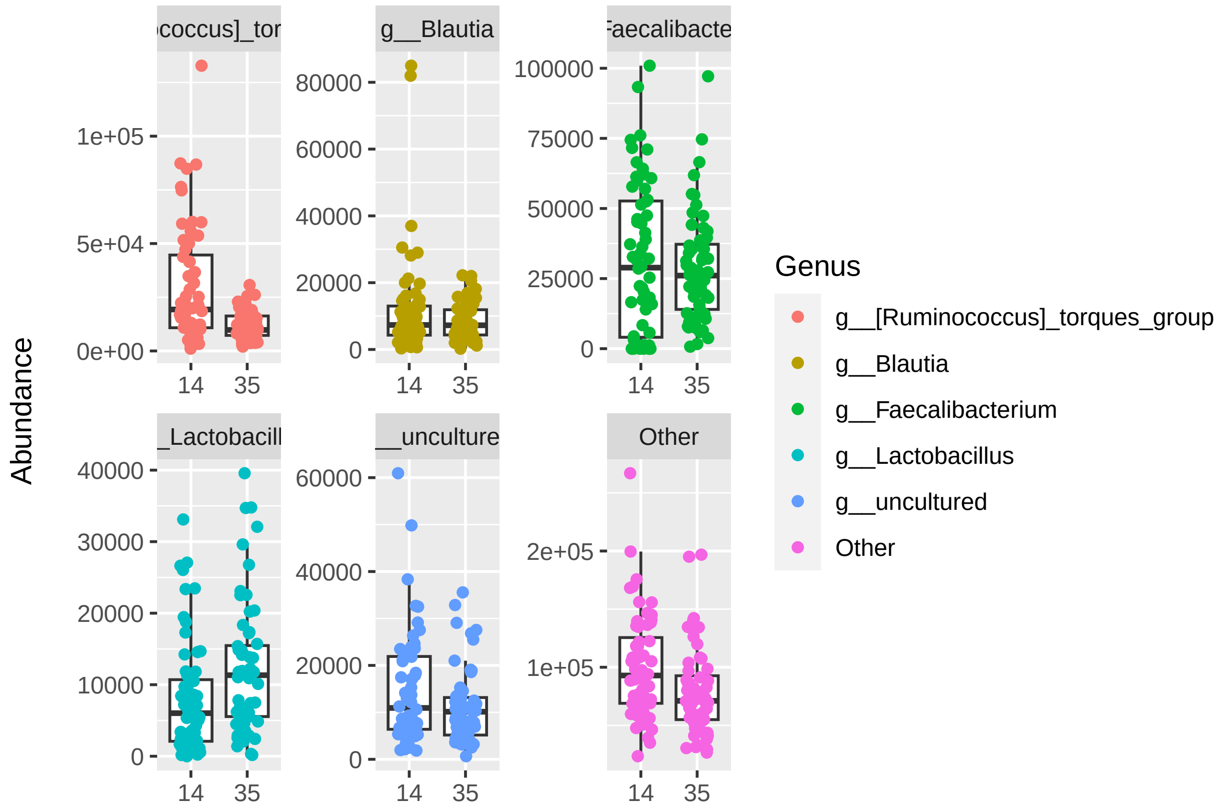

```r
psmelt(ps_prim) %>% # Agent
  ggplot(data = ., aes(x = Cox, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Phylum), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Phylum, scales = "free")
```



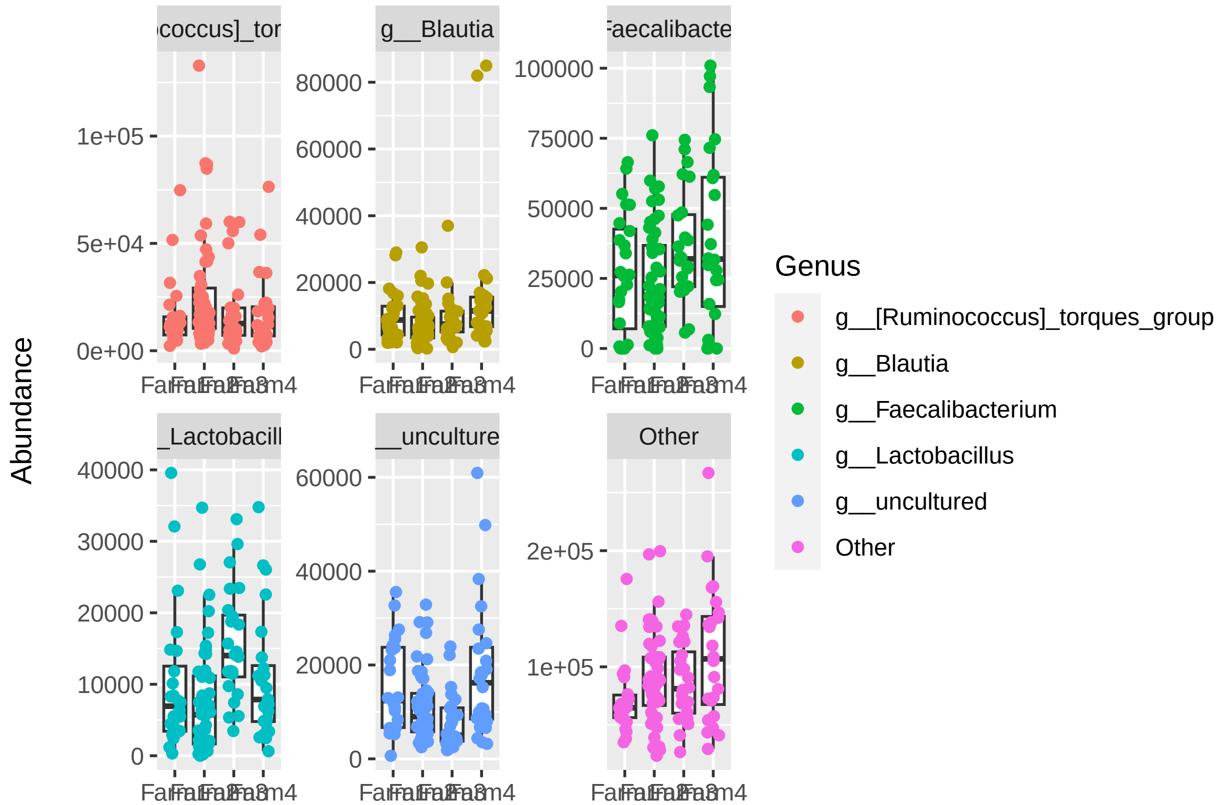

```r
# visualisation on AB at Genus level, more data for samples which have not been treated with AB, but al

ps_prim <- subset16S %>% aggregate_top_taxa2("Genus", top = 5) %>% phyloseq::tax_glom("Genus")
taxa_names(ps_prim) <- phyloseq::tax_table(ps_prim)[, "Genus"]

psmelt(ps_prim) %>% # AB
  ggplot(data = ., aes(x = AB, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Genus), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Genus, scales = "free")
```



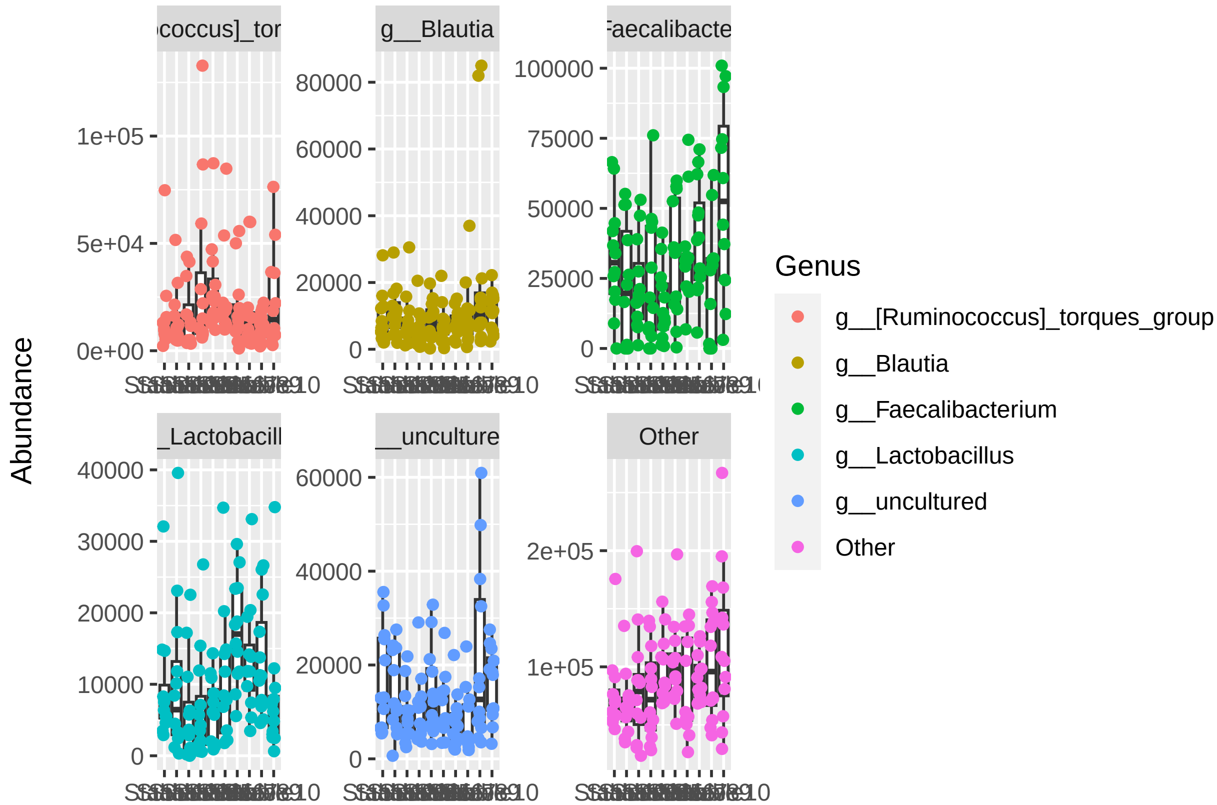

```
psmelt(ps_prim) %>% # Age
  ggplot(data = ., aes(x = Age, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Genus), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Genus, scales = "free")
```



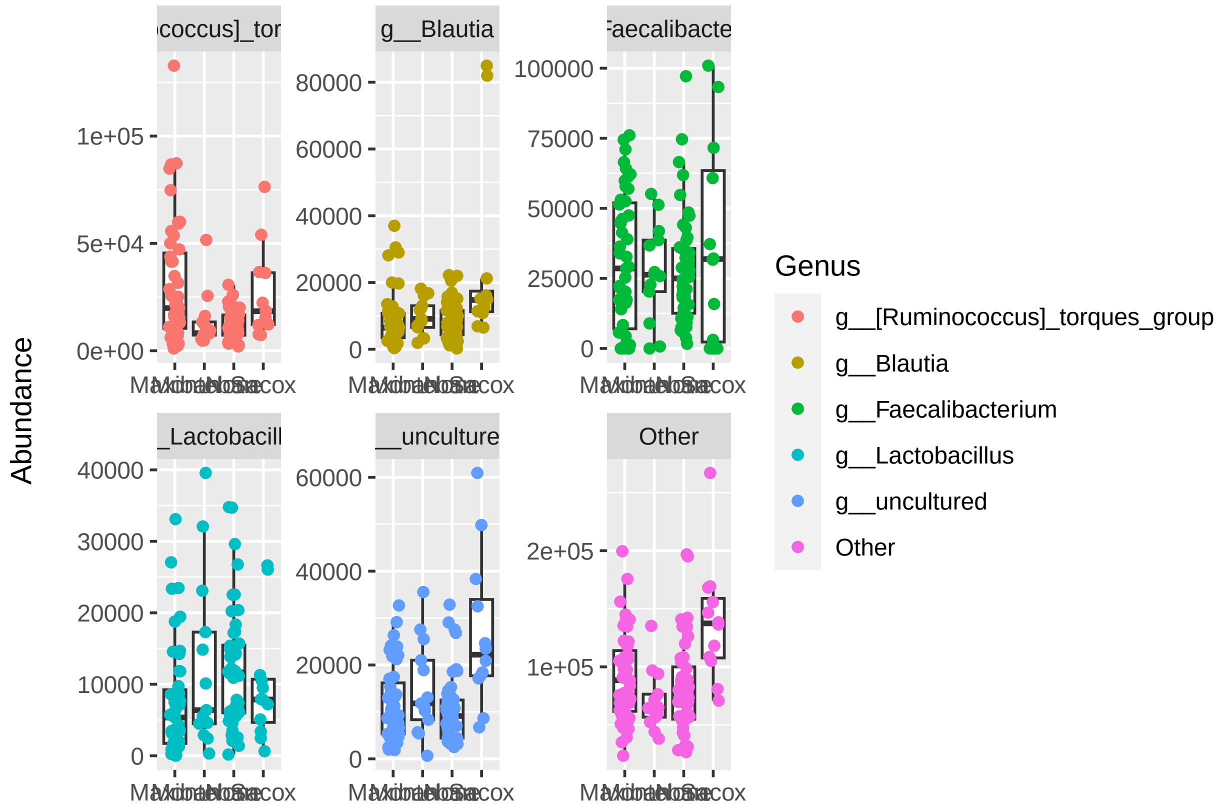

```r
psmelt(ps_prim) %>% # Farm
  ggplot(data = ., aes(x = Farm2, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Genus), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Genus, scales = "free")
```




```
psmelt(ps_prim) %>% # Stable
  ggplot(data = ., aes(x = Stables, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Genus), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Genus, scales = "free")
```




```r
psmelt(ps_prim) %>% # Agent
  ggplot(data = ., aes(x = Cox, y = Abundance)) +
  geom_boxplot(outlier.shape  = NA) +
  geom_jitter(aes(color = Genus), height = 0, width = .2) +
  labs(x = "", y = "Abundance\n") +
  facet_wrap(~ Genus, scales = "free")
```




```r
# Check the amount of unique genera in samples which have and have not been treated with antibiotics
subset16S %>% ps_filter(AB == "no") %>% get_taxa_unique("Genus") # 93 different genera for non AB treat
```

```
##  [1] "g__"
##  [2] "g__Dielma"
##  [3] "g__uncultured"
##  [4] "g__Anaeroplasma"
##  [5] "g__Merdibacter"
##  [6] "g__Erysipelatoclostridium"
##  [7] "g__Blautia"
##  [8] "g__Odoribacter"
##  [9] "g__Parabacteroides"
## [10] "g__Coprobacter"
## [11] "g__Bacteroides"
## [12] "g__Alistipes"
## [13] "g__Bilophila"
## [14] "g__Parasutterella"
## [15] "g__Ralstonia"
## [16] "g__Escherichia-Shigella"
## [17] "g__Corynebacterium_1"
## [18] "g__Brachybacterium"
## [19] "g__Bifidobacterium"
## [20] "g__Ruminococcaceae_UCG-014"
## [21] "g__Lachnospiraceae_UCG-008"
## [22] "g__CHKCI002"
## [23] "g__Gordonibacter"
```

```
## [24] "g__Akkermansia"
## [25] "g__Paraeggerthella"
## [26] "g__Christensenellaceae_R-7_group"
## [27] "g__uncultured_bacterium"
## [28] "g__Ruminococcaceae_UCG-010"
## [29] "g__Tyzzerella_3"
## [30] "g__Family_XIII_AD3011_group"
## [31] "g__Romboutsia"
## [32] "g__Staphylococcus"
## [33] "g__Caldalkalibacillus"
## [34] "g__Lactobacillus"
## [35] "g__Weissella"
## [36] "g__Bacillus"
## [37] "g__Enterococcus"
## [38] "g__Eisenbergiella"
## [39] "g__Streptococcus"
## [40] "g__Phascolarctobacterium"
## [41] "g__uncultured_organism"
## [42] "g__Anaerofustis"
## [43] "g__Ruminococcaceae_UCG-013"
## [44] "g__Butyricicoccus"
## [45] "g__Faecalibacterium"
## [46] "g__Phocea"
## [47] "g__Subdoligranulum"
## [48] "g__GCA-900066225"
## [49] "g__[Eubacterium]_coprostanoligenes_group"
## [50] "g__Negativibacillus"
## [51] "g__Hydrogenoanaerobacterium"
## [52] "g__Angelakisella"
## [53] "g__Fournierella"
## [54] "g__Anaerofilum"
## [55] "g__Anaerotruncus"
## [56] "g__[Ruminococcus]_torques_group"
## [57] "g__Sellimonas"
## [58] "g__Lachnoclostridium"
## [59] "g__GCA-900066575"
## [60] "g__CHKCI001"
## [61] "g__UC5-1-2E3"
## [62] "g__Fusicatenibacter"
## [63] "g__Roseburia"
## [64] "g__Marvinbryantia"
## [65] "g__Coprococcus_3"
## [66] "g__Lachnospiraceae_UCG-006"
## [67] "g__[Ruminococcus]_gauvreauii_group"
## [68] "g__Lachnospiraceae_UCG-004"
## [69] "g__Lachnospiraceae_FCS020_group"
## [70] "g__Lachnospiraceae_FE2018_group"
## [71] "g__[Eubacterium]_ventriosum_group"
## [72] "g__Shuttleworthia"
## [73] "g__[Eubacterium]_hallii_group"
## [74] "g__Anaerostipes"
## [75] "g__UBA1819"
## [76] "g__Ruminococcus_1"
## [77] "g__Defluviitaleaceae_UCG-011"
```

```
## [78] "g__ASF356"
## [79] "g__Tyzzerella"
## [80] "g__[Eubacterium]_nodatum_group"
## [81] "g__Ruminiclostridium_9"
## [82] "g__Ruminiclostridium_5"
## [83] "g__Ruminiclostridium"
## [84] "g__Oscillospira"
## [85] "g__Oscillibacter"
## [86] "g__Ruminococcus_2"
## [87] "g__Ruminococcaceae_UCG-009"
## [88] "g__Ruminococcaceae_UCG-005"
## [89] "g__DTU089"
## [90] "g__Candidatus_Soleaferrea"
## [91] "g__Ruminococcaceae_NK4A214_group"
## [92] "g__Flavonifractor"
## [93] "g__Intestinimonas"
```

```r
subset16S %>% ps_filter(AB == "yes") %>% get_taxa_unique("Genus") # 74 different genera for AB treated
```

```
##  [1] "g__"
##  [2] "g__uncultured"
##  [3] "g__Anaeroplasma"
##  [4] "g__Merdibacter"
##  [5] "g__Erysipelatoclostridium"
##  [6] "g__Odoribacter"
##  [7] "g__Bacteroides"
##  [8] "g__Alistipes"
##  [9] "g__uncultured_bacterium"
## [10] "g__Bilophila"
## [11] "g__Parasutterella"
## [12] "g__Escherichia-Shigella"
## [13] "g__Bifidobacterium"
## [14] "g__Ruminococcaceae_UCG-014"
## [15] "g__CHKCI002"
## [16] "g__Gordonibacter"
## [17] "g__Akkermansia"
## [18] "g__Christensenellaceae_R-7_group"
## [19] "g__Ruminococcaceae_UCG-010"
## [20] "g__Tyzzerella_3"
## [21] "g__Romboutsia"
## [22] "g__Lactobacillus"
## [23] "g__Bacillus"
## [24] "g__Enterococcus"
## [25] "g__Eisenbergiella"
## [26] "g__Streptococcus"
## [27] "g__Phascolarctobacterium"
## [28] "g__Anaerofustis"
## [29] "g__Ruminococcaceae_UCG-013"
## [30] "g__Butyricicoccus"
## [31] "g__Faecalibacterium"
## [32] "g__Phocea"
## [33] "g__Subdoligranulum"
## [34] "g__GCA-900066225"
## [35] "g__Negativibacillus"
```

```
## [36] "g__Hydrogenoanaerobacterium"
## [37] "g__Anaerofilum"
## [38] "g__Anaerotruncus"
## [39] "g__Fournierella"
## [40] "g__[Ruminococcus]_torques_group"
## [41] "g__Sellimonas"
## [42] "g__GCA-900066575"
## [43] "g__Blautia"
## [44] "g__CHKCI001"
## [45] "g__UC5-1-2E3"
## [46] "g__Fusicatenibacter"
## [47] "g__Marvinbryantia"
## [48] "g__Coprococcus_3"
## [49] "g__Lachnospiraceae_UCG-006"
## [50] "g__Lachnospiraceae_UCG-008"
## [51] "g__Lachnoclostridium"
## [52] "g__Lachnospiraceae_UCG-004"
## [53] "g__Lachnospiraceae_FCS020_group"
## [54] "g__Shuttleworthia"
## [55] "g__Ruminiclostridium_9"
## [56] "g__[Eubacterium]_hallii_group"
## [57] "g__Anaerostipes"
## [58] "g__Roseburia"
## [59] "g__Defluviitaleaceae_UCG-011"
## [60] "g__ASF356"
## [61] "g__Tyzzerella"
## [62] "g__[Eubacterium]_nodatum_group"
## [63] "g__Ruminococcus_1"
## [64] "g__Oscillospira"
## [65] "g__Oscillibacter"
## [66] "g__Ruminiclostridium"
## [67] "g__[Eubacterium]_coprostanoligenes_group"
## [68] "g__Ruminococcaceae_UCG-005"
## [69] "g__DTU089"
## [70] "g__Ruminiclostridium_5"
## [71] "g__Ruminococcus_2"
## [72] "g__Candidatus_Soleaferrea"
## [73] "g__Ruminococcaceae_NK4A214_group"
## [74] "g__Flavonifractor"
```

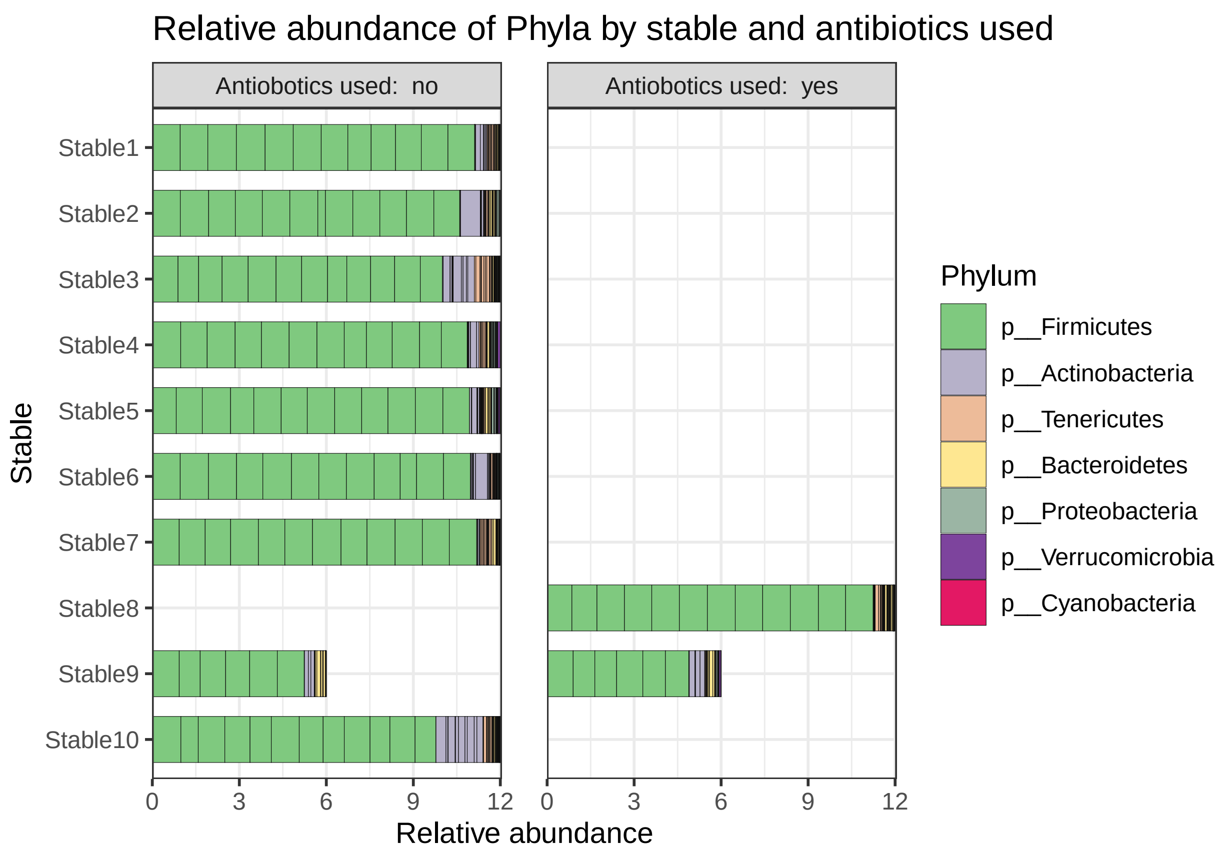
```
subset16S %>% get_taxa_unique("Genus") # 93 different genes in total, which are all present in non-trea
```

```
##  [1] "g__"
##  [2] "g__Dielma"
##  [3] "g__uncultured"
##  [4] "g__Anaeroplasma"
##  [5] "g__Merdibacter"
##  [6] "g__Erysipelatoclostridium"
##  [7] "g__Blautia"
##  [8] "g__Odoribacter"
##  [9] "g__Parabacteroides"
## [10] "g__Coprobacter"
## [11] "g__Bacteroides"
## [12] "g__Alistipes"
```

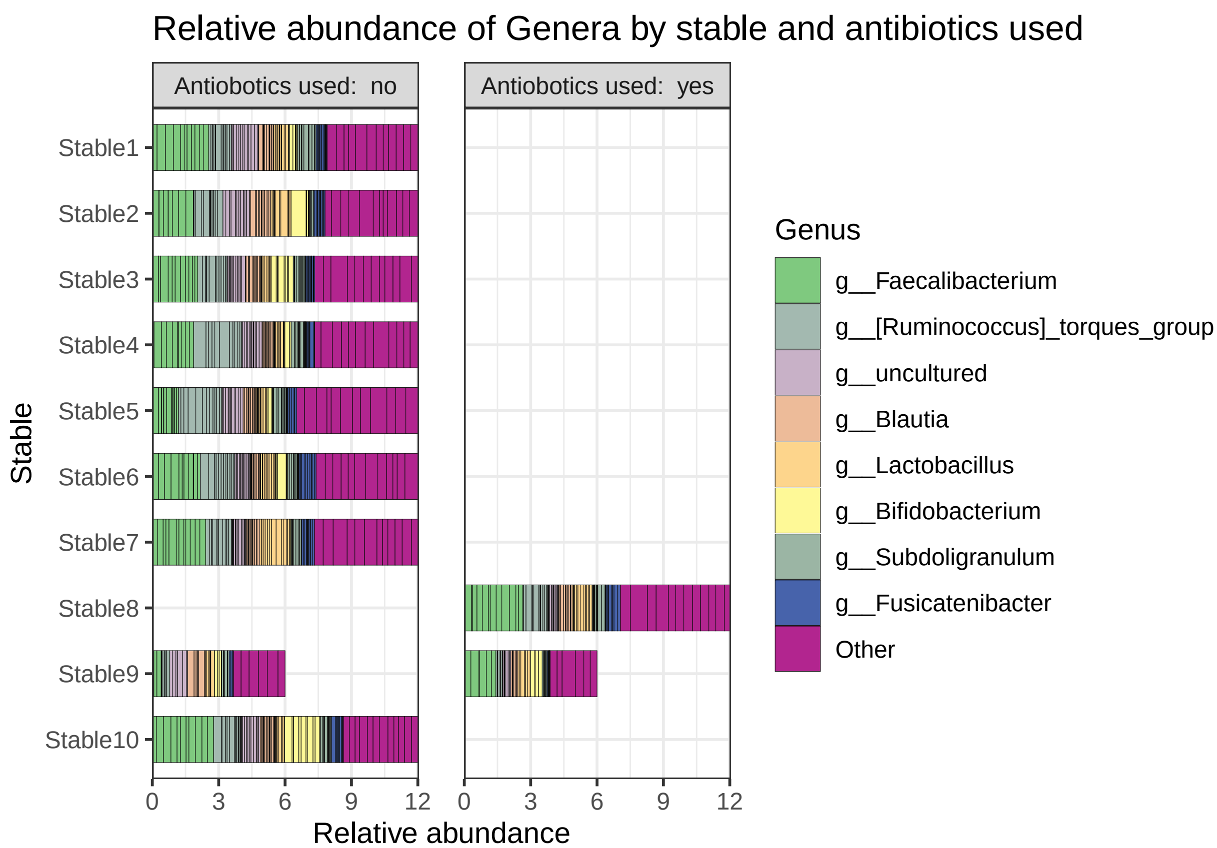
```
## [13] "g__uncultured_bacterium"
## [14] "g__Bilophila"
## [15] "g__Parasutterella"
## [16] "g__Ralstonia"
## [17] "g__Escherichia-Shigella"
## [18] "g__Corynebacterium_1"
## [19] "g__Brachybacterium"
## [20] "g__Bifidobacterium"
## [21] "g__Ruminococcaceae_UCG-014"
## [22] "g__Lachnospiraceae_UCG-008"
## [23] "g__CHKCI002"
## [24] "g__Gordonibacter"
## [25] "g__Akkermansia"
## [26] "g__Paraeggerthella"
## [27] "g__Christensenellaceae_R-7_group"
## [28] "g__Ruminococcaceae_UCG-010"
## [29] "g__Tyzzerella_3"
## [30] "g__Romboutsia"
## [31] "g__Family_XIII_AD3011_group"
## [32] "g__Staphylococcus"
## [33] "g__Caldalkalibacillus"
## [34] "g__Lactobacillus"
## [35] "g__Weissella"
## [36] "g__Bacillus"
## [37] "g__Enterococcus"
## [38] "g__Eisenbergiella"
## [39] "g__Streptococcus"
## [40] "g__Phascolarctobacterium"
## [41] "g__uncultured_organism"
## [42] "g__Anaerofustis"
## [43] "g__Ruminococcaceae_UCG-013"
## [44] "g__Butyricicoccus"
## [45] "g__Faecalibacterium"
## [46] "g__Phocea"
## [47] "g__Subdoligranulum"
## [48] "g__GCA-900066225"
## [49] "g__[Eubacterium]_coprostanoligenes_group"
## [50] "g__Negativibacillus"
## [51] "g__Hydrogenoanaerobacterium"
## [52] "g__Angelakisella"
## [53] "g__Fournierella"
## [54] "g__Anaerofilum"
## [55] "g__Anaerotruncus"
## [56] "g__[Ruminococcus]_torques_group"
## [57] "g__Sellimonas"
## [58] "g__Lachnoclostridium"
## [59] "g__GCA-900066575"
## [60] "g__CHKCI001"
## [61] "g__UC5-1-2E3"
## [62] "g__Fusicatenibacter"
## [63] "g__Roseburia"
## [64] "g__Marvinbryantia"
## [65] "g__Coprococcus_3"
## [66] "g__Lachnospiraceae_UCG-006"
```

```
## [67] "g__[Ruminococcus]_gauvreauii_group"
## [68] "g__Lachnospiraceae_UCG-004"
## [69] "g__Lachnospiraceae_FCS020_group"
## [70] "g__Lachnospiraceae_FE2018_group"
## [71] "g__[Eubacterium]_ventriosum_group"
## [72] "g__Shuttleworthia"
## [73] "g__Ruminiclostridium_9"
## [74] "g__[Eubacterium]_hallii_group"
## [75] "g__Anaerostipes"
## [76] "g__UBA1819"
## [77] "g__Ruminococcus_1"
## [78] "g__Defluviitaleaceae_UCG-011"
## [79] "g__ASF356"
## [80] "g__Tyzzerella"
## [81] "g__[Eubacterium]_nodatum_group"
## [82] "g__Ruminiclostridium_5"
## [83] "g__Ruminiclostridium"
## [84] "g__Oscillospira"
## [85] "g__Oscillibacter"
## [86] "g__Ruminococcus_2"
## [87] "g__Ruminococcaceae_UCG-009"
## [88] "g__Ruminococcaceae_UCG-005"
## [89] "g__DTU089"
## [90] "g__Candidatus_Soleaferrea"
## [91] "g__Ruminococcaceae_NK4A214_group"
## [92] "g__Flavonifractor"
## [93] "g__Intestinimonas"
```

```r
# Plots of relative abundances, fixing some genes that are clustered in the data twice, showing top 12

# Relative abundance for both stable and antibiotics used

subset16S %>%
  ps_arrange(Stables) %>%
  ps_mutate(
    Stables = factor(Stables, rev(unique(Stables)))
  ) %>%
  comp_barplot(
    tax_level = "Phylum", bar_width = 0.7, sample_order = "asis",
    palette = colorRampPalette(brewer.pal(8,"Accent"))(9),
    x = "Stables") +
  facet_wrap(
    facets = vars(AB), labeller = as_labeller(~ paste("Antiobotics used: ", .)),
    scales = "fixed"
  ) +
  coord_flip() +
  labs(x = "Stable", y = "Relative abundance") +
  scale_y_continuous(expand = expansion(add = c(0, 0.05))) +
  theme_bw() +
  theme(panel.spacing.x = unit(6, "mm")) +
  ggtitle("Relative abundance of Phyla by stable and antibiotics used")
```




```r
# Same plot but with Genus

subset16S %>% aggregate_top_taxa2("Genus", top = 8) %>% phyloseq::tax_glom("Genus") %>%
  ps_arrange(Stables) %>%
  ps_mutate(
    Stables = factor(Stables, rev(unique(Stables)))
  ) %>%
  comp_barplot(
    tax_level = "Genus", bar_width = 0.7, sample_order = "asis",
    palette = colorRampPalette(brewer.pal(8,"Accent"))(13),
    x = "Stables",
    n_taxa = 12, other_name = "Other ARG", merge_other = F) +
  facet_wrap(
    facets = vars(AB), labeller = as_labeller(~ paste("Antiobotics used: ", .)),
    scales = "fixed"
  ) +
  coord_flip() +
  labs(x = "Stable", y = "Relative abundance") +
  scale_y_continuous(expand = expansion(add = c(0, 0.05))) +
  theme_bw() +
  theme(panel.spacing.x = unit(6, "mm")) +
  ggtitle("Relative abundance of Genera by stable and antibiotics used")
```



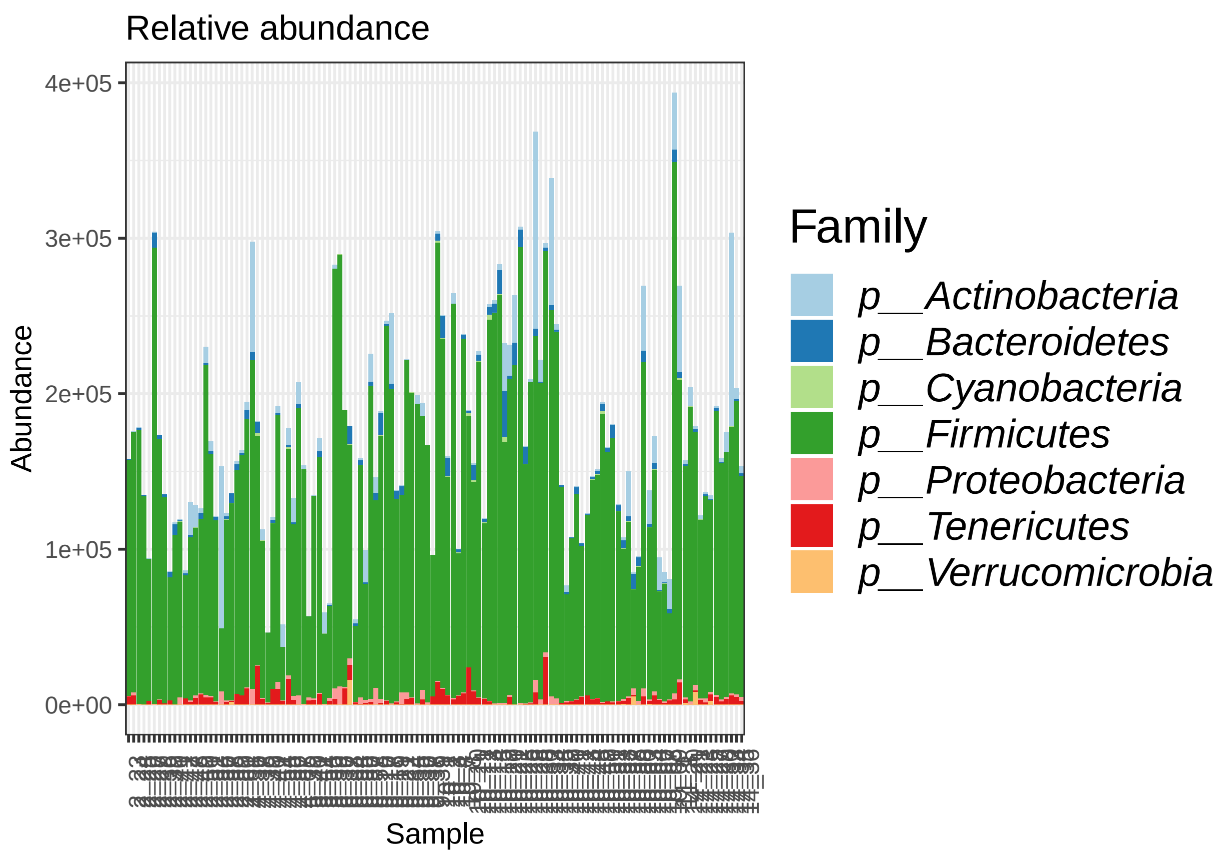
Rel abundance Phyla

```
ps1.com <- subset16S

taxa_names(ps1.com) <- paste0("ASV_", rownames(tax_table(ps1.com)))

# set Palette
taxic <- as.data.frame(ps1.com@tax_table) # this will help in setting large color options
taxic$OTU <- rownames(taxic) # Add the OTU ids from OTU table into the taxa table at the end.
colnames(taxic) # You can see that we now have extra taxonomy levels.
```

```
## [1] "Domain" "Phylum" "Class"  "Order"  "Family" "Genus"  "OTU"
```

```
taxmat <- as.matrix(taxic) # convert it into a matrix.
new.tax <- tax_table(taxmat) # convert into phyloseq compatible file.
tax_table(ps1.com) <- new.tax # incroporate into phyloseq Object

# now edit the unclassified taxa
tax_table(ps1.com)[tax_table(ps1.com)[, "Phylum"] == "", "Phylum"] <- "Unclassified phylum"

guide_italics <- guides(fill = guide_legend(label.theme = element_text(
  size = 15,
```

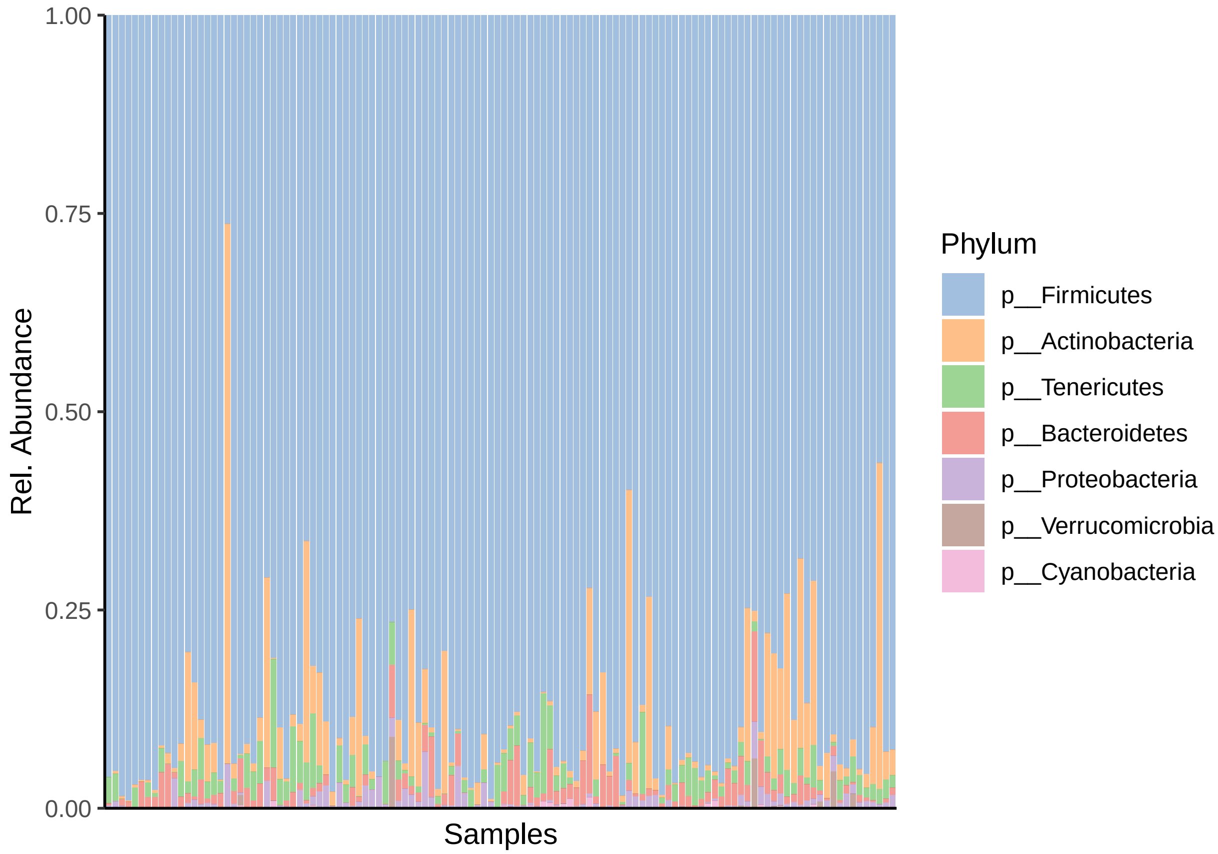
```
  face = "italic", colour = "Black", angle = 0
)))


ps1.com@phy_tree <- NULL

#  merge at phylum level

ps1.com.fam <- microbiomeutilities::aggregate_top_taxa2(ps1.com, "Phylum", top = 10)

plot_composition(ps1.com.fam) + theme(legend.position = "bottom") +
  scale_fill_brewer("Family", palette = "Paired") + theme_bw() +
  theme(axis.text.x = element_text(angle = 90)) +
  ggtitle("Relative abundance") + guide_italics + theme(legend.title = element_text(size = 18))
```



Other Phyla plots

```
tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)

tse <- transformCounts(tse, method = "relabundance")

tse_phylum <- agglomerateByRank(tse,
                               rank = "Phylum",
                               onRankOnly = TRUE)
tse_phylum <- transformCounts(tse_phylum,
                             assay.type = "counts",
```

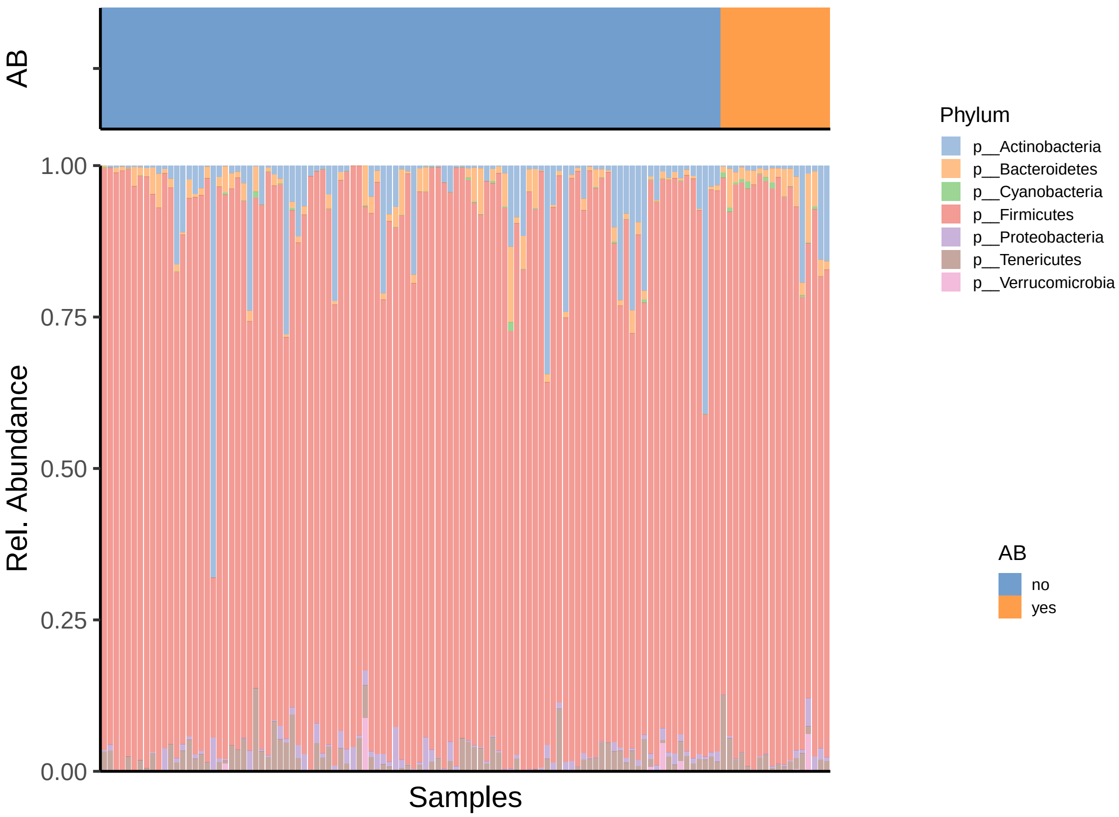
```r
                                   method = "relabundance")

miaViz::plotAbundance(tse_phylum,
                      assay.type = "relabundance",
                      rank = "Phylum",
                      order_rank_by = "abund")
```



Same plot but with antibiotic treatment added in

```r
tse_phylum$Farm2 = as.factor(tse_phylum$Farm2)
tse_phylum$AB = as.factor(tse_phylum$AB)

plots <- miaViz::plotAbundance(tse_phylum,
                               assay.type = "relabundance",
                               rank = "Phylum",
                               order_sample_by = "AB",
                               features = "AB")

plots[[1]] <- plots[[1]] +
  theme(legend.key.size = unit(0.3, 'cm'),
        legend.text = element_text(size = 6),
        legend.title = element_text(size = 8))
plots[[2]] <- plots[[2]] +
  theme(legend.key.height = unit(0.3, 'cm'),
        legend.key.width = unit(0.3, 'cm'),
        legend.text = element_text(size = 6),
```

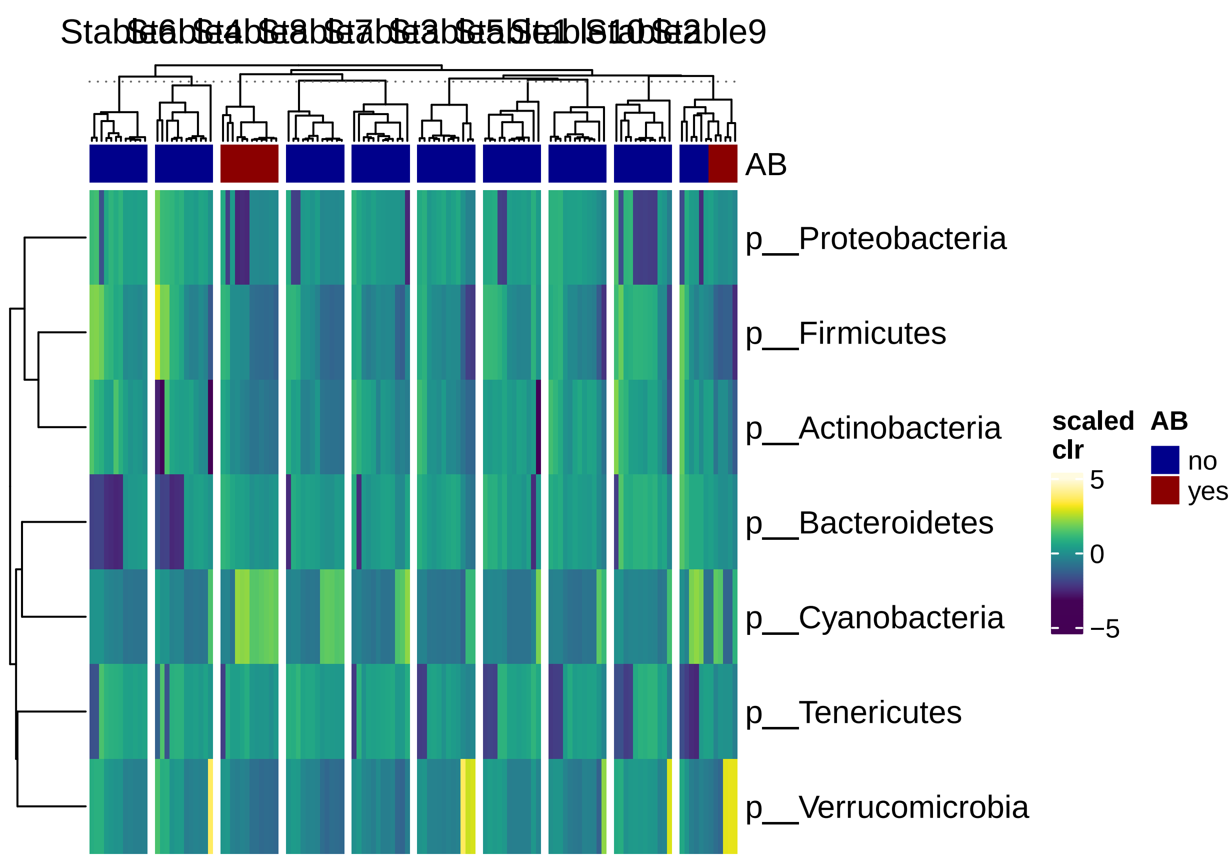
```
        legend.title = element_text(size = 8),
        legend.direction = "vertical")

legend <- wrap_plots(as_ggplot(get_legend(plots[[1]])), as_ggplot(get_legend(plots[[2]])), ncol = 1)
plots[[1]] <- plots[[1]] + theme(legend.position = "none")
plots[[2]] <- plots[[2]] + theme(legend.position = "none", axis.title.x=element_blank())

plot <- wrap_plots(plots[[2]], plots[[1]], ncol = 1, heights = c(2, 10))
wrap_plots(plot, legend, nrow = 1, widths = c(2, 1))
```



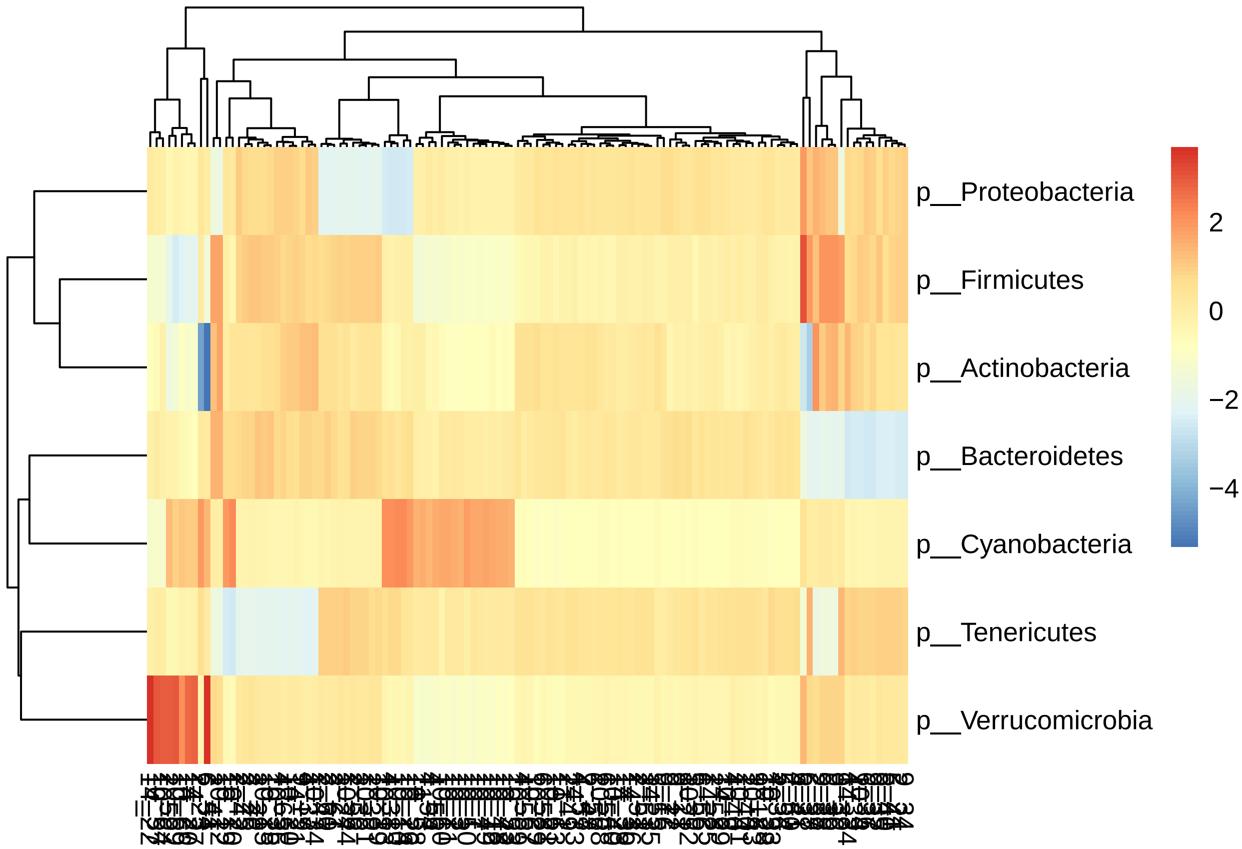
heatmaps on phylum level

```
tse_phylum <- agglomerateByRank(tse,
                                rank = "Phylum",
                                onRankOnly = TRUE)

tse_phylum <- transformCounts(tse_phylum, MARGIN = "samples", method = "clr", assay.type = "counts", ps
tse_phylum <- transformCounts(tse_phylum, assay.type = "clr",
                              MARGIN = "features",
                              method = "z", name = "clr_z")


#top_taxa <- getTopTaxa(tse_phylum, top = 20) there are few phyla in this data so no need to exclude so
#tse_phylum <- tse_phylum[top_taxa, ]

# Phylum AB heatmap
```

```
tse_phylum@metadata$anno_colors$AB = c(yes = "darkred",no ="darkblue")

sechm(tse_phylum,
      features = rownames(tse_phylum),
      assayName = "clr",
      do.scale = TRUE,
      top_annotation = "AB",
      gaps_at = "Stables",
      hmcols = viridis(256),
      cluster_cols = TRUE, cluster_rows = TRUE,
      sortRowsOn=NULL)
```

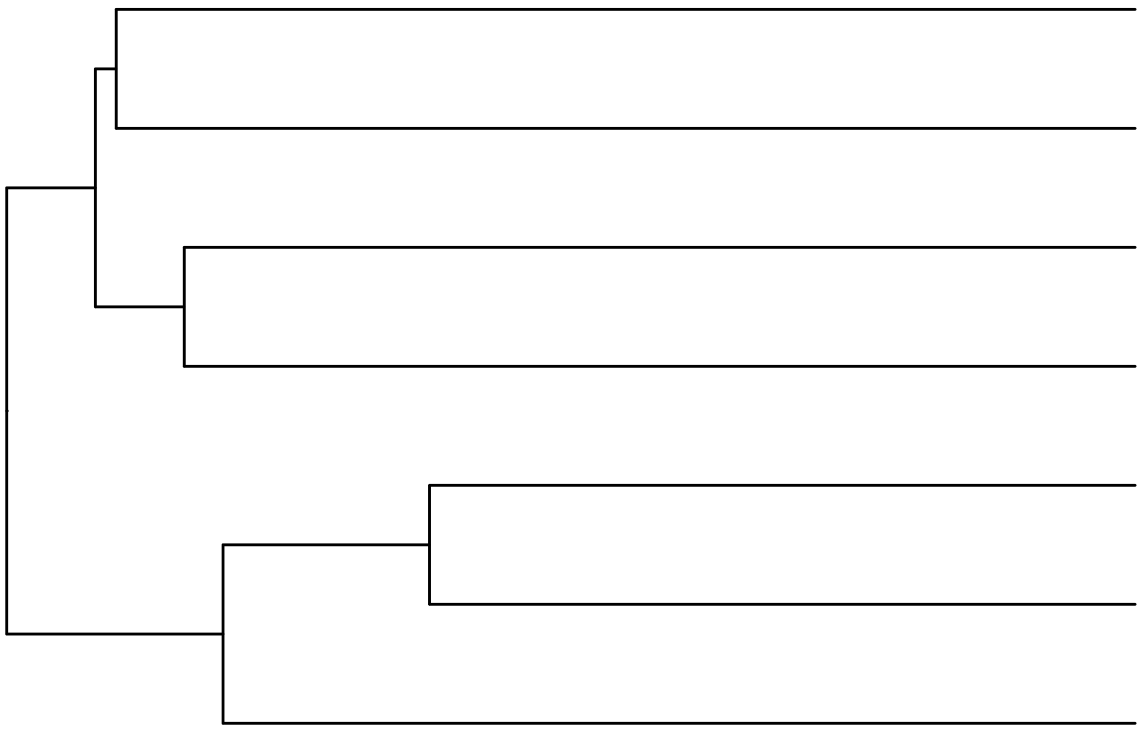



```
# Phylum heatmap
mat <- assay(tse_phylum, "clr_z")

pheatmap(mat)
```



Phylum heatmap hierarchal clustering with AB Clustering both samples and features hierarchically

```
taxa_hclust <- hclust(dist(mat), method = "complete")

# Creates a phylogenetic tree
taxa_tree <- as.phylo(taxa_hclust)

# Plot taxa tree
taxa_tree <- ggtree(taxa_tree) +
  theme(plot.margin=margin(0,0,0,0)) # removes margins

taxa_tree # based on this three, we'll create two clusters
```



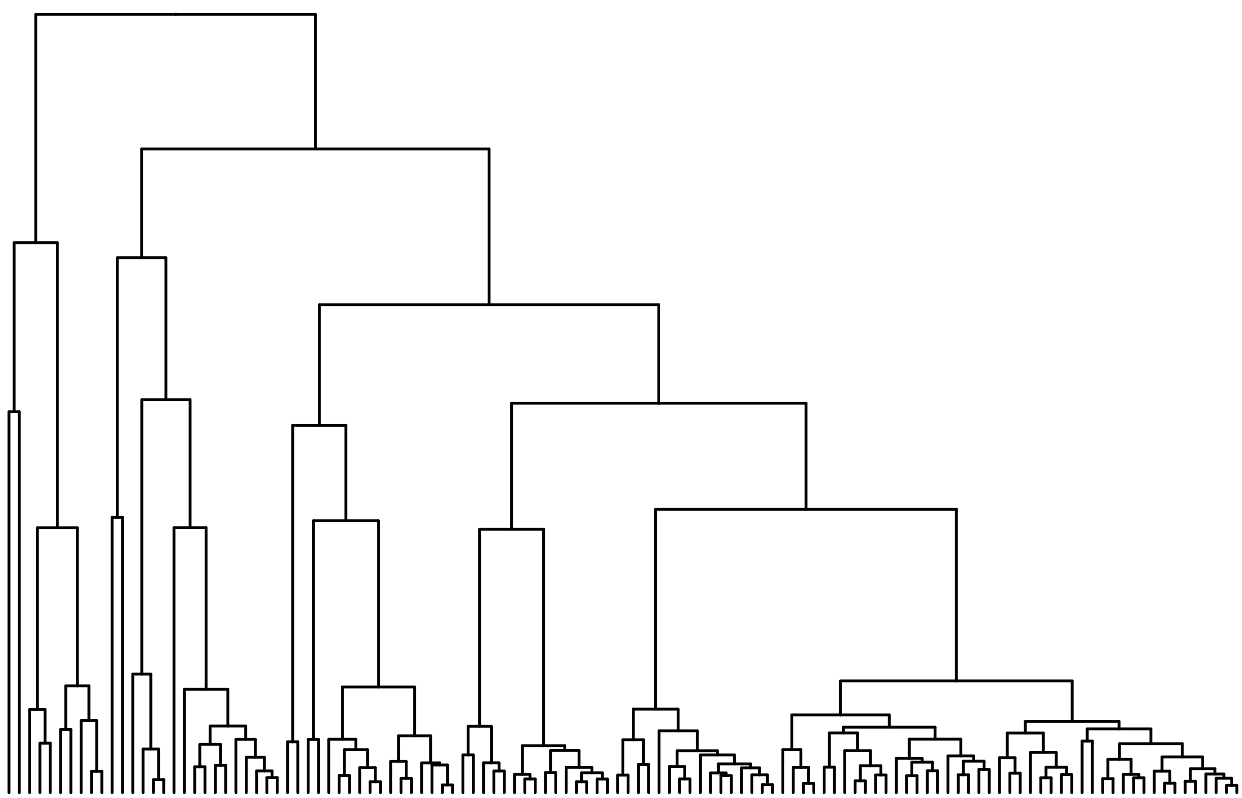
```r
# Get order of taxa in plot
taxa_ordered <- get_taxa_name(taxa_tree)

taxa_clusters <- cutree(tree = taxa_hclust, k = 2) # 2 clusters based on tree figure

# Converts into data frame
taxa_clusters <- data.frame(clusters = taxa_clusters)
taxa_clusters$clusters <- factor(taxa_clusters$clusters)

# Order data so that it's same as in phylo tree
taxa_clusters <- taxa_clusters[taxa_ordered, , drop = FALSE]

# Prints taxa and their clusters
taxa_clusters
```

```
##                      clusters
## p__Verrucomicrobia          1
## p__Tenericutes              1
## p__Cyanobacteria            1
## p__Bacteroidetes            1
## p__Actinobacteria           2
## p__Firmicutes               2
## p__Proteobacteria           2
```

```r
rowData(tse_phylum)$clusters <- taxa_clusters[order(match(rownames(taxa_clusters), rownames(tse_phylum)

# Prints taxa and their clusters
rowData(tse_phylum)$clusters
```

```
## [1] 1 2 1 2 2 1 1
## Levels: 1 2
```

```r
sample_hclust <- hclust(dist(t(mat)), method = "complete")

# Creates a phylogenetic tree
sample_tree <- as.phylo(sample_hclust)

# Plot sample tree
sample_tree <- ggtree(sample_tree) + layout_dendrogram() +
  theme(plot.margin=margin(0,0,0,0)) # removes margins

# Get order of samples in plot
samples_ordered <- rev(get_taxa_name(sample_tree))

# to view the tree, run
sample_tree
```



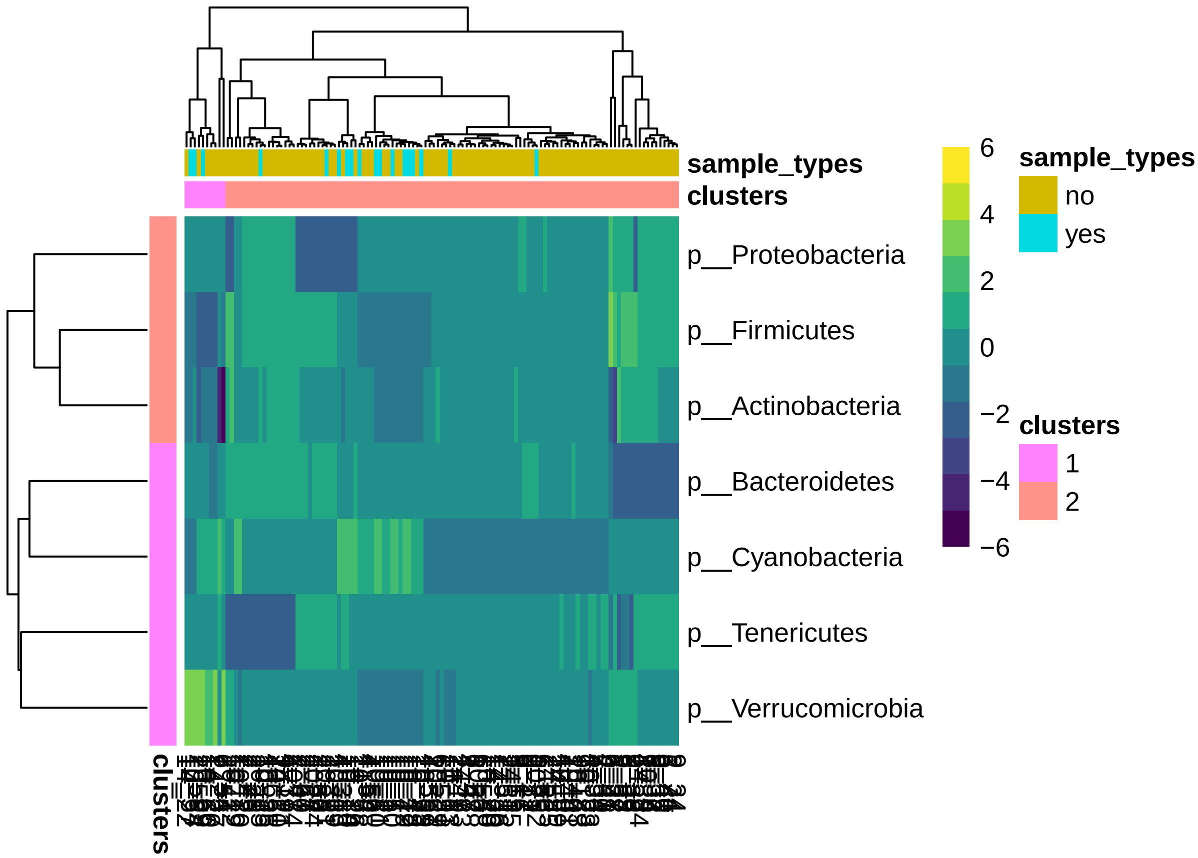
```r
# Creates clusters
sample_clusters <- factor(cutree(tree = sample_hclust, k = 2)) # 2 clusters based on methods in Cluster

# Converts into data frame
sample_data <- data.frame(clusters = sample_clusters)

# Order data so that it's same as in phylo tree
sample_data <- sample_data[samples_ordered, , drop = FALSE]

# Order data based on
tse_phylum <- tse_phylum[ , rownames(sample_data)]

# Add sample type data
sample_data$sample_types <- colData(tse_phylum)$AB

sample_data
```

```
##       clusters sample_types
## 2_23         1           no
## 6_54         1           no
## 14_22        1           no
## 10_57        1          yes
## 10_64        1          yes
## 2_59         1           no
## 10_59        1          yes
## 10_66        1           no
## 14_20        1           no
## 14_27        1           no
## 6_37         2           no
## 6_38         2           no
## 2_57         2           no
## 9_38         2           no
## 5_39         2           no
## 9_36         2           no
## 9_39         2           no
## 14_34        2           no
## 4_39         2           no
## 10_4         2           no
## 6_36         2           no
## 9_37         2           no
## 9_35         2           no
## 5_40         2           no
## 5_41         2           no
## 2_24         2           no
## 9_34         2           no
## 2_41         2           no
## 10_22        2           no
## 10_19        2           no
## 10_20        2           no
## 2_42         2           no
## 2_25         2           no
## 2_26         2           no
## 2_29         2           no
```

```
## 10_15          2            yes
## 10_25          2             no
## 9_19           2             no
## 4_37           2             no
## 10_34          2             no
## 10_35          2             no
## 4_65           2             no
## 10_30          2             no
## 14_21          2             no
## 10_14          2            yes
## 10_26          2             no
## 10_13          2            yes
## 4_38           2             no
## 10_10          2            yes
## 2_47           2             no
## 2_60           2             no
## 2_61           2             no
## 2_27           2             no
## 10_44          2             no
## 2_56           2             no
## 2_36           2             no
## 10_51          2            yes
## 2_39           2             no
## 10_39          2             no
## 10_58          2            yes
## 11_3           2             no
## 4_54           2             no
## 4_56           2             no
## 10_60          2            yes
## 10_11          2            yes
## 10_2           2             no
## 10_3           2             no
## 10_50          2            yes
## 10_1           2             no
## 10_7           2             no
## 10_49          2            yes
## 10_12          2            yes
## 10_48          2            yes
## 10_42          2             no
## 10_53          2            yes
## 9_22           2             no
## 9_17           2             no
## 9_21           2             no
## 10_52          2            yes
## 9_18           2             no
## 10_28          2             no
## 10_33          2             no
## 4_36           2             no
## 5_54           2             no
## 2_50           2             no
## 4_41           2             no
## 5_59           2             no
## 6_56           2             no
## 14_25          2             no
```

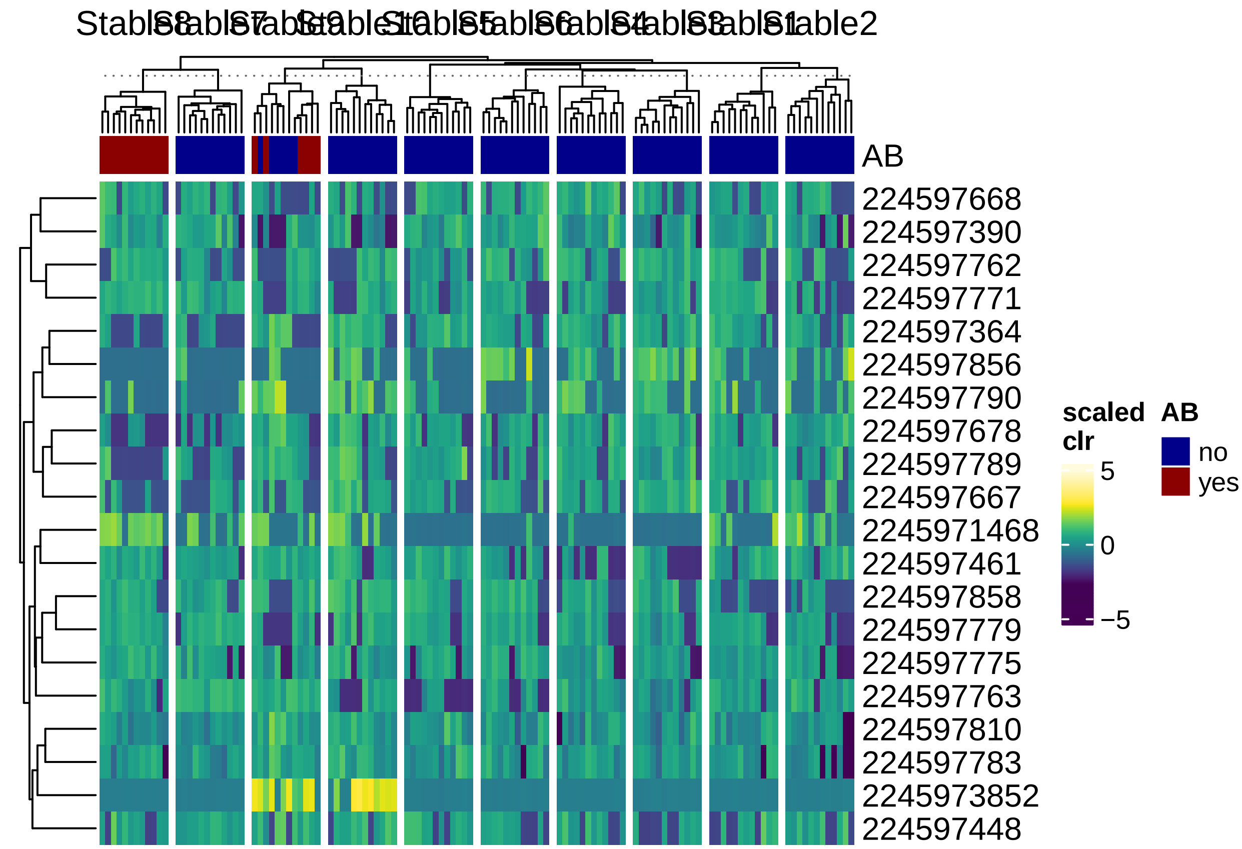
```
## 2_58          2           no
## 14_29         2           no
## 10_8          2           no
## 4_40          2           no
## 10_41         2           no
## 2_40          2           no
## 10_43         2           no
## 10_69         2           no
## 4_55          2           no
## 10_67         2           no
## 10_29         2           no
## 6_58          2           no
## 10_21         2           no
## 10_63         2          yes
## 11_1          2           no
## 5_55          2           no
## 9_16          2           no
## 2_49          2           no
## 14_33         2           no
## 4_57          2           no
## 2_48          2           no
## 6_57          2           no
## 10_68         2           no
## 6_55          2           no
## 10_40         2           no
## 14_23         2           no
## 14_30         2           no
## 14_36         2           no
## 2_52          2           no
## 2_51          2           no
## 14_35         2           no
```

```
breaks <- seq(-ceiling(max(abs(mat))), ceiling(max(abs(mat))),
              length.out = ifelse( max(abs(mat))>5, 2*ceiling(max(abs(mat))), 10 ) )
#colors <- colorRampPalette(c("darkblue", "blue", "white", "red", "darkred"))(length(breaks)-1) replace

pheatmap(mat, annotation_row = taxa_clusters,
         annotation_col = sample_data,
         breaks = breaks,
         color = colorRampPalette(viridis(256))(length(breaks)-1))
```



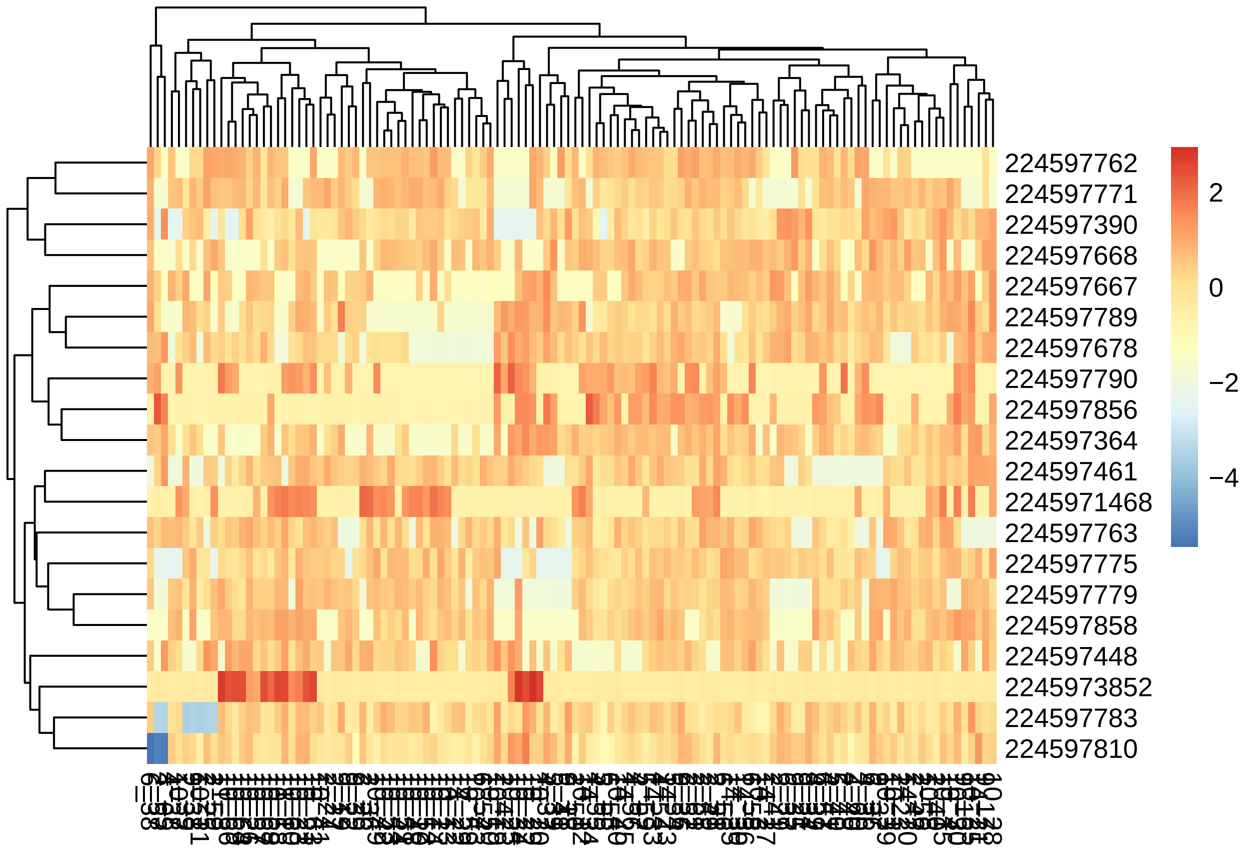
heatmaps on ASV level

```
tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)
tse <- transformCounts(tse, method = "relabundance")
tse <- transformCounts(tse, MARGIN = "samples", method = "clr", assay.type = "counts", pseudocount=1) #
tse <- transformCounts(tse, assay.type = "clr",
                              MARGIN = "features",
                              method = "z", name = "clr_z")
top_taxa <- getTopTaxa(tse, top = 20)
tse <- tse[top_taxa, ]

# ASV heatmap AB
tse@metadata$anno_colors$AB = c(yes = "darkred",no ="darkblue")

sechm(tse,
      features = rownames(tse),
      assayName = "clr",
      do.scale = TRUE,
      top_annotation = c("AB"),
      gaps_at = "Stables",
      hmcols = viridis(256),
      cluster_cols = TRUE, cluster_rows = TRUE)
```

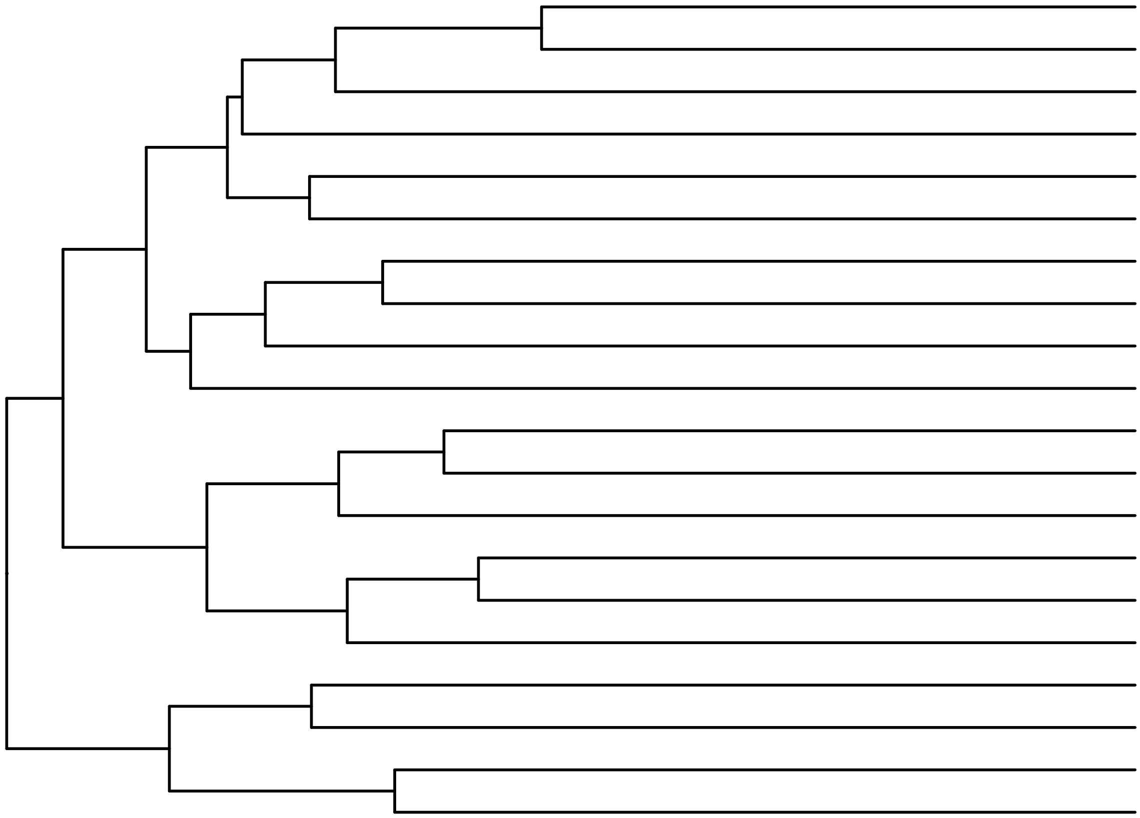


ASV heatmap

```
mat <- assay(tse, "clr_z")

pheatmap(mat)
```




```r
# ASV heatmap hierarchal clustering with AB

# Clustering both samples and features hierarchically

taxa_hclust <- hclust(dist(mat), method = "complete")

# Creates a phylogenetic tree
taxa_tree <- as.phylo(taxa_hclust)

# Plot taxa tree
taxa_tree <- ggtree(taxa_tree) +
  theme(plot.margin=margin(0,0,0,0)) # removes margins

taxa_tree # based on this three, we'll create two clusters
```



```r
# Get order of taxa in plot
taxa_ordered <- get_taxa_name(taxa_tree)

taxa_clusters <- cutree(tree = taxa_hclust, k = 2) # 2 clusters based on methods in Clustering.R script

# Converts into data frame
taxa_clusters <- data.frame(clusters = taxa_clusters)
taxa_clusters$clusters <- factor(taxa_clusters$clusters)

# Order data so that it's same as in phylo tree
taxa_clusters <- taxa_clusters[taxa_ordered, , drop = FALSE]

# Prints taxa and their clusters
taxa_clusters
```

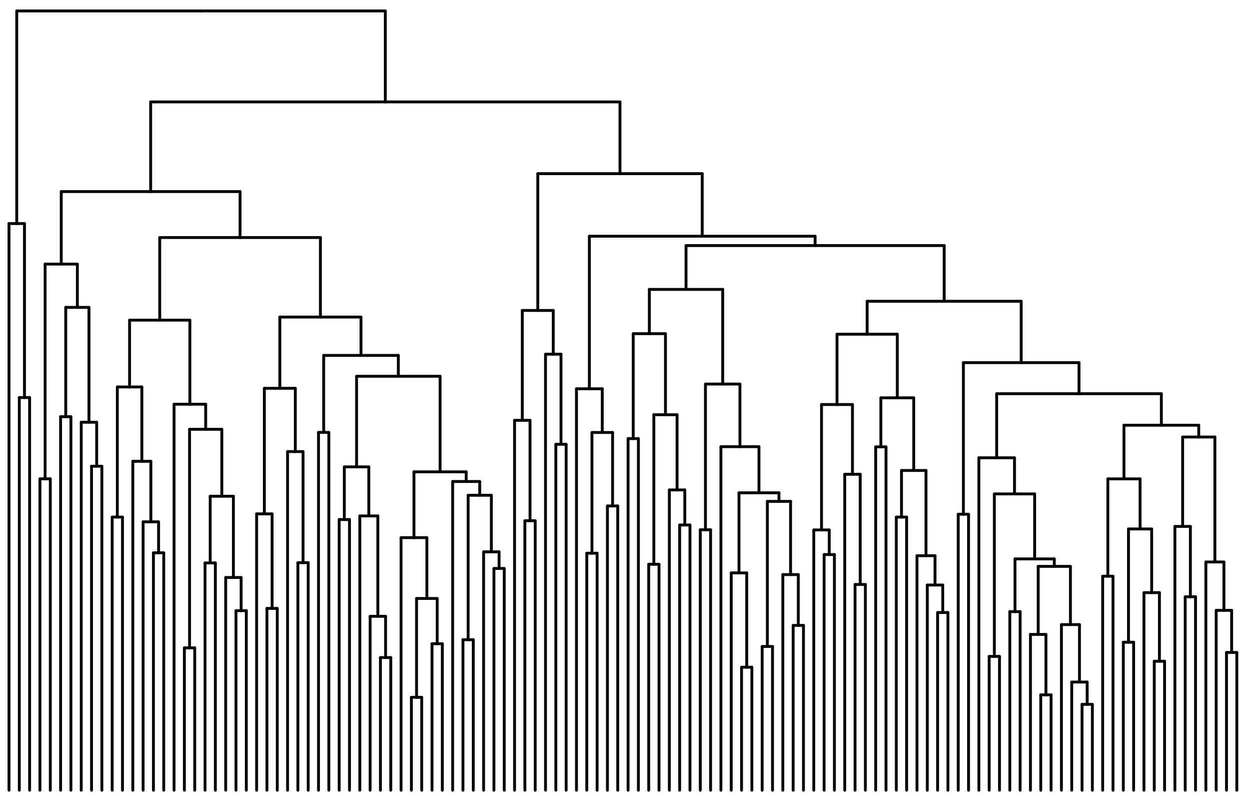
```
##              clusters
## 224597858           1
## 224597779           1
## 224597775           1
## 224597763           1
## 2245971468          1
## 224597461           1
## 224597810           1
## 224597783           1
## 2245973852          1
## 224597448           1
```

```
## 224597364         1
## 224597856         1
## 224597790         1
## 224597678         1
## 224597789         1
## 224597667         1
## 224597668         2
## 224597390         2
## 224597771         2
## 224597762         2
```

```
# Prints taxa and their clusters
rowData(tse_phylum)$clusters
```

```
## [1] 1 2 1 2 2 1 1
## Levels: 1 2
```

```
sample_hclust <- hclust(dist(t(mat)), method = "complete")

# Creates a phylogenetic tree
sample_tree <- as.phylo(sample_hclust)

# Plot sample tree
sample_tree <- ggtree(sample_tree) + layout_dendrogram() +
  theme(plot.margin=margin(0,0,0,0)) # removes margins

# Get order of samples in plot
samples_ordered <- rev(get_taxa_name(sample_tree))

# to view the tree, run
sample_tree
```



```r
# Creates clusters
sample_clusters <- factor(cutree(tree = sample_hclust, k = 2))

# Converts into data frame
sample_data <- data.frame(clusters = sample_clusters)

# Order data so that it's same as in phylo tree
sample_data <- sample_data[samples_ordered, , drop = FALSE]

# Order data based on
tse_phylum <- tse_phylum[ , rownames(sample_data)]

# Add sample type data
sample_data$sample_types <- colData(tse_phylum)$AB

sample_data
```

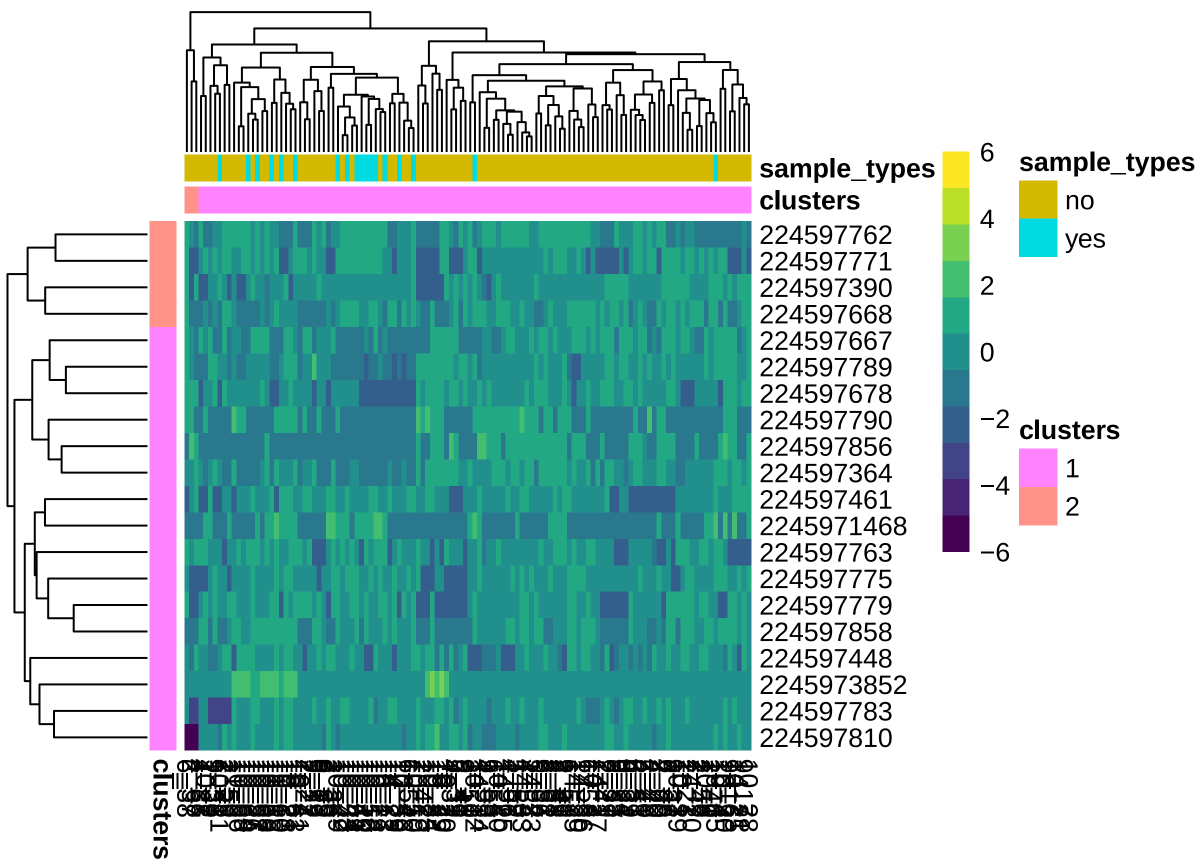
```
##        clusters sample_types
## 6_38          2           no
## 2_57          2           no
## 4_65          2           no
## 4_38          1           no
## 10_7          1           no
## 2_25          1           no
## 2_59          1           no
## 2_39          1           no
```

```
## 9_38           1           no
## 10_11          1          yes
## 10_58          1          yes
## 11_1           1           no
## 10_60          1          yes
## 10_33          1           no
## 10_21          1           no
## 10_63          1          yes
## 11_3           1           no
## 10_66          1           no
## 10_69          1           no
## 10_67          1           no
## 10_68          1           no
## 10_64          1          yes
## 10_26          1           no
## 10_57          1          yes
## 10_41          1           no
## 2_24           1           no
## 2_27           1           no
## 9_19           1           no
## 9_22           1           no
## 9_39           1           no
## 2_26           1           no
## 2_36           1           no
## 14_22          1           no
## 14_29          1           no
## 10_59          1          yes
## 10_43          1           no
## 6_54           1           no
## 10_50          1          yes
## 10_49          1          yes
## 10_42          1           no
## 10_53          1          yes
## 10_44          1           no
## 10_51          1          yes
## 10_48          1          yes
## 10_10          1          yes
## 10_52          1          yes
## 10_14          1          yes
## 10_2           1           no
## 10_13          1          yes
## 10_19          1           no
## 2_42           1           no
## 10_25          1           no
## 10_34          1           no
## 10_22          1           no
## 10_29          1           no
## 10_20          1           no
## 4_37           1           no
## 5_39           1           no
## 5_41           1           no
## 9_18           1           no
## 10_4           1           no
## 10_30          1           no
```

```
## 9_16           1          no
## 10_35          1          no
## 14_21          1          no
## 9_17           1          no
## 10_28          1          no
## 6_36           1          no
## 9_37           1          no
## 10_39          1          no
## 10_1           1          no
## 2_23           1          no
## 14_20          1          no
## 2_47           1          no
## 2_56           1          no
## 10_8           1          no
## 2_40           1          no
## 10_15          1         yes
## 2_41           1          no
## 2_29           1          no
## 6_37           1          no
## 9_35           1          no
## 9_21           1          no
## 9_34           1          no
## 2_60           1          no
## 4_36           1          no
## 2_48           1          no
## 4_40           1          no
## 4_39           1          no
## 6_57           1          no
## 4_41           1          no
## 5_40           1          no
## 2_50           1          no
## 10_12          1         yes
## 14_34          1          no
## 4_55           1          no
## 5_55           1          no
## 6_55           1          no
## 10_40          1          no
## 14_25          1          no
## 4_56           1          no
## 4_57           1          no
## 5_59           1          no
## 14_33          1          no
## 4_54           1          no
## 14_23          1          no
## 5_54           1          no
## 9_36           1          no
## 2_52           1          no
## 2_61           1          no
## 2_58           1          no
## 2_49           1          no
## 2_51           1          no
## 6_58           1          no
## 10_3           1          no
## 14_27          1          no
```

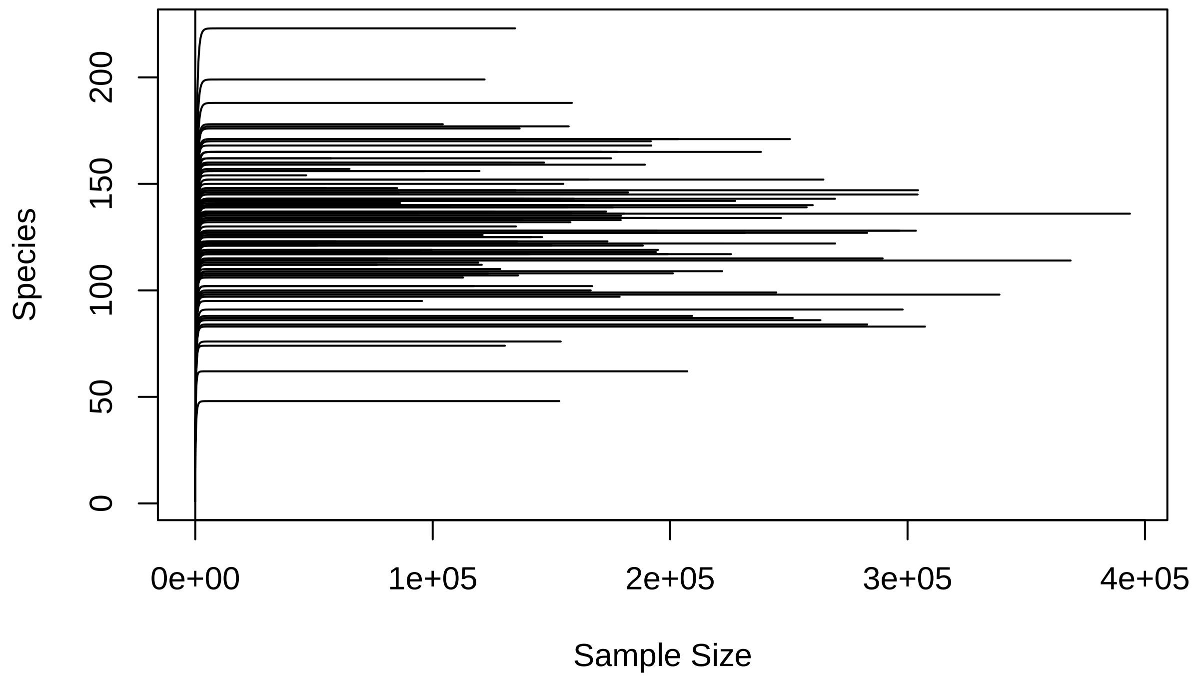
```
## 6_56          1           no
## 14_35         1           no
## 14_30         1           no
## 14_36         1           no
```

```
breaks <- seq(-ceiling(max(abs(mat))), ceiling(max(abs(mat))),
              length.out = ifelse( max(abs(mat))>5, 2*ceiling(max(abs(mat))), 10 ) )

pheatmap(mat, annotation_row = taxa_clusters,
         annotation_col = sample_data,
         breaks = breaks,
         color = colorRampPalette(viridis(256))(length(breaks)-1))
```



Alpha diversity

```
otu_tab <- t(abundances(subset16S))
# rarefaction curve
vegan::rarecurve(otu_tab,
                 step = 50, label = FALSE,
                 sample = min(rowSums(otu_tab),
                              col = "blue", cex = 0.6))
```




```r
# samples plateau so sufficient sequencing depth

summary(goods(otu_tab)) # there are no singletons in this data, already filtered out, means that richne
```

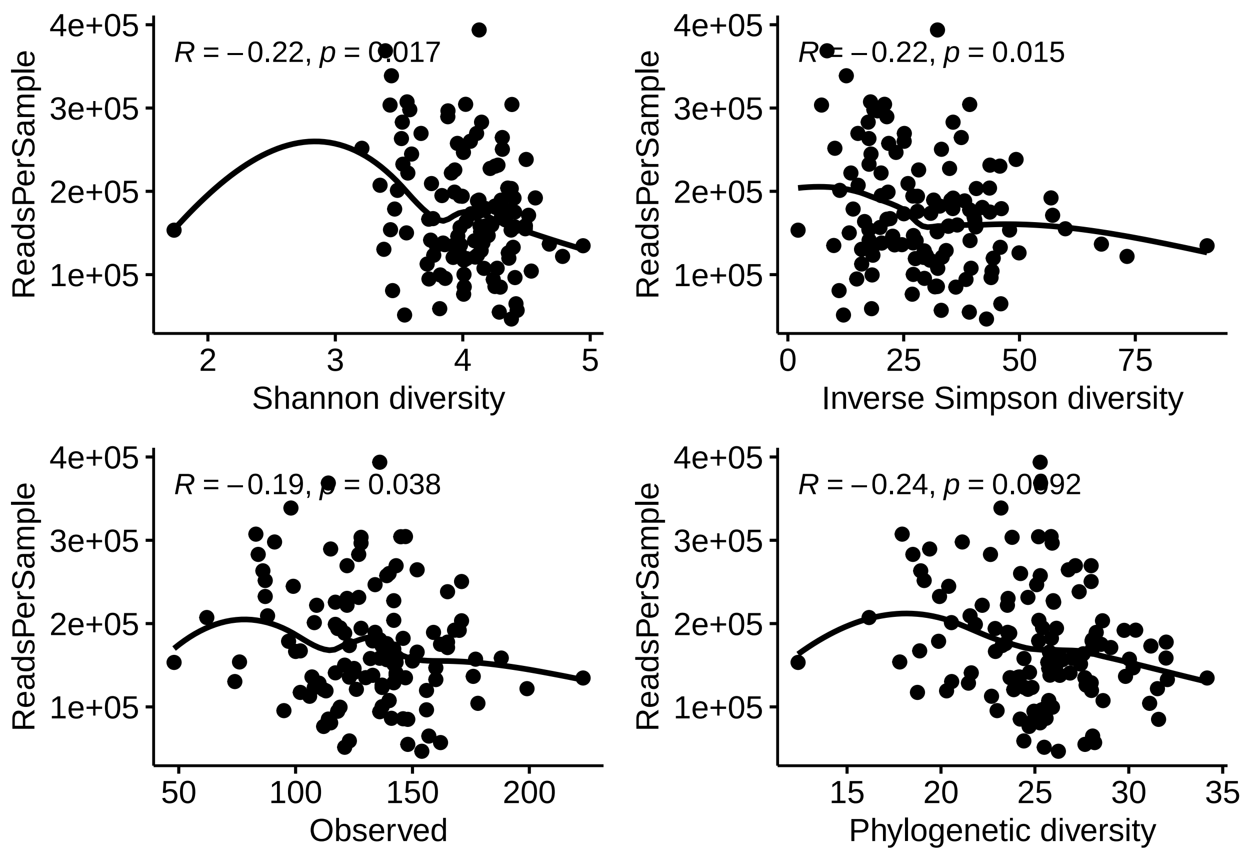
```
##     no.sing     no.seqs           goods
##  Min.    :0   Min.    : 46731   Min.   :100
##  1st Qu.:0   1st Qu.:125421   1st Qu.:100
##  Median :0   Median :161649   Median :100
##  Mean    :0   Mean    :173742   Mean   :100
##  3rd Qu.:0   3rd Qu.:212488   3rd Qu.:100
##  Max.    :0   Max.    :393697   Max.   :100
```

```r
#rarefy to equal library size or not?
lib.div <- microbiome::alpha(subset16S, index = "all")
lib.div2 <- richness(subset16S)
lib.div$ReadsPerSample <- sample_sums(subset16S)
lib.div$Observed <- lib.div2$observed
colnames(lib.div)
```

```
##  [1] "observed"                  "chao1"
##  [3] "diversity_inverse_simpson" "diversity_gini_simpson"
##  [5] "diversity_shannon"         "diversity_fisher"
##  [7] "diversity_coverage"        "evenness_camargo"
##  [9] "evenness_pielou"           "evenness_simpson"
## [11] "evenness_evar"             "evenness_bulla"
```

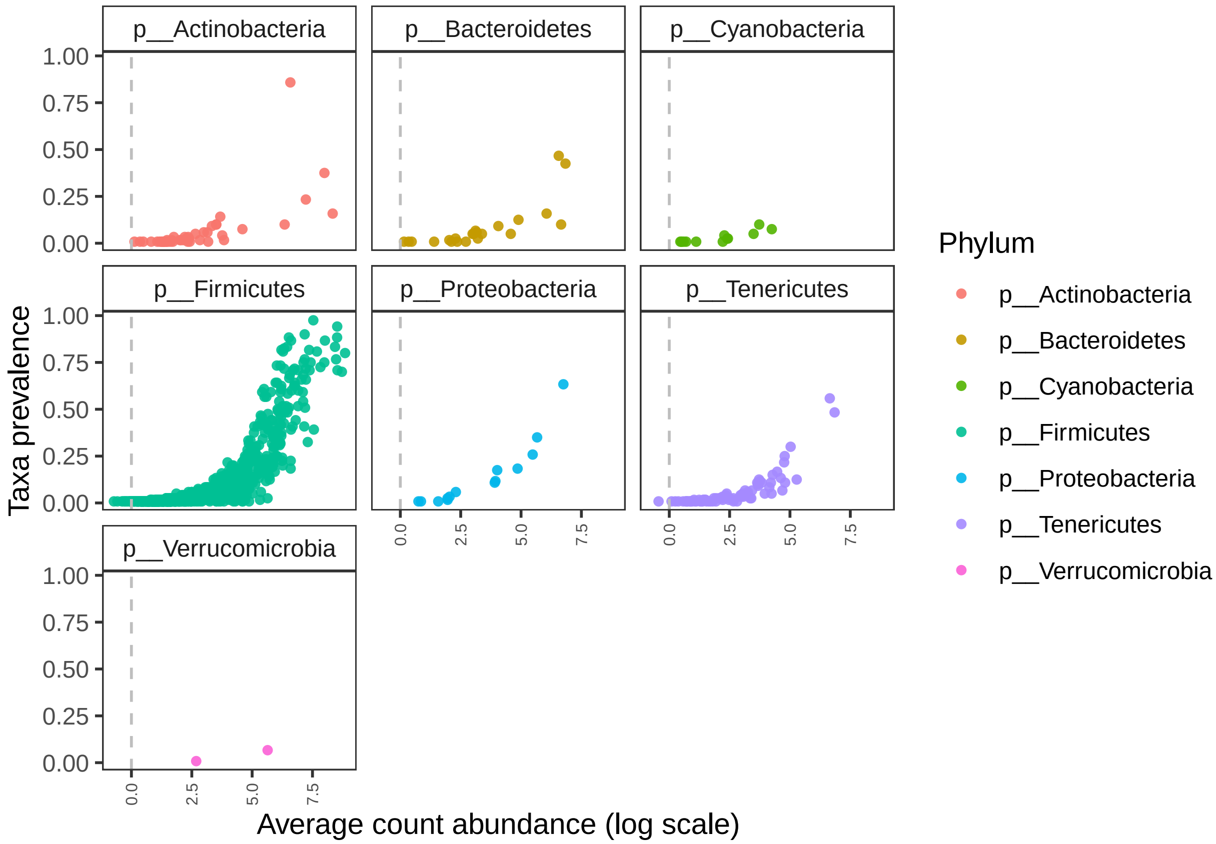
```
## [13] "dominance_dbp"                "dominance_dmn"
## [15] "dominance_absolute"           "dominance_relative"
## [17] "dominance_simpson"            "dominance_core_abundance"
## [19] "dominance_gini"               "rarity_log_modulo_skewness"
## [21] "rarity_low_abundance"         "rarity_rare_abundance"
## [23] "ReadsPerSample"               "Observed"
```

```
p1 = ggscatter(lib.div, "diversity_shannon", "ReadsPerSample", xlab = "Shannon diversity", add = "loess
  stat_cor(method = "pearson")
p2 = ggscatter(lib.div, "diversity_inverse_simpson", "ReadsPerSample",  xlab = "Inverse Simpson diversi
  stat_cor(method = "pearson")
p3 = ggscatter(lib.div, "observed", "ReadsPerSample",  xlab = "Observed", add = "loess") +
  stat_cor(method = "pearson")

df.pd <- pd(t(as.data.frame(subset16S@otu_table)), subset16S@phy_tree,include.root=T) # transposing for
lib.div$Phylogenetic_Diversity <- df.pd$PD

p4 = ggscatter(lib.div, "Phylogenetic_Diversity", "ReadsPerSample",  xlab = "Phylogenetic diversity", a
  stat_cor(method = "pearson")

ggarrange(p1, p2, p3, p4, ncol = 2, nrow = 2)
```



removal of samples with lower sequencing depth not necessary for 16S dataset

```
plot_taxa_prevalence(subset16S, "Phylum") # taxa prevalence plot
```



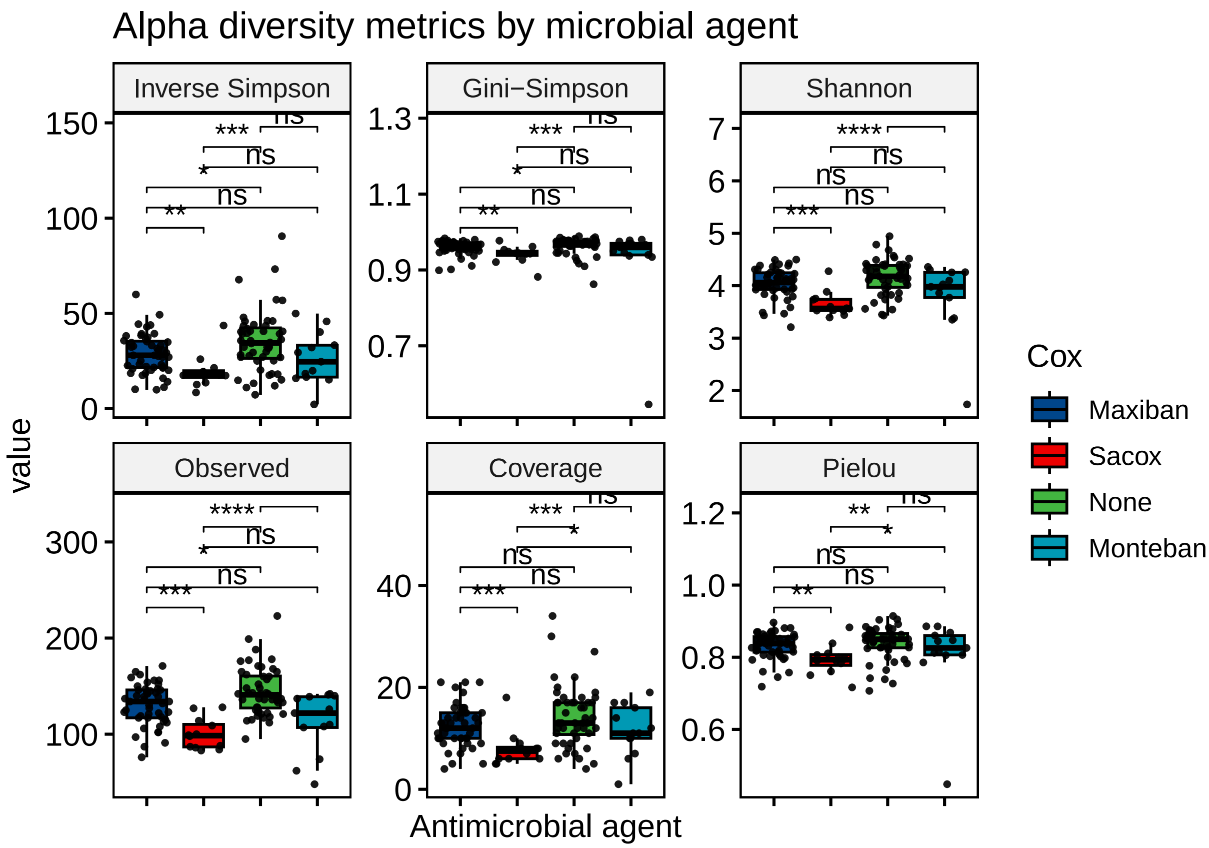
Diversity metrics boxplots

```
hmp.div <- microbiome::alpha(subset16S, index = "all")
hmp.meta <- meta(subset16S)
hmp.meta$sam_name <- rownames(hmp.meta)
hmp.div$sam_name <- rownames(hmp.div)
div.df <- merge(hmp.div,hmp.meta, by = "sam_name")
colnames(div.df)
```

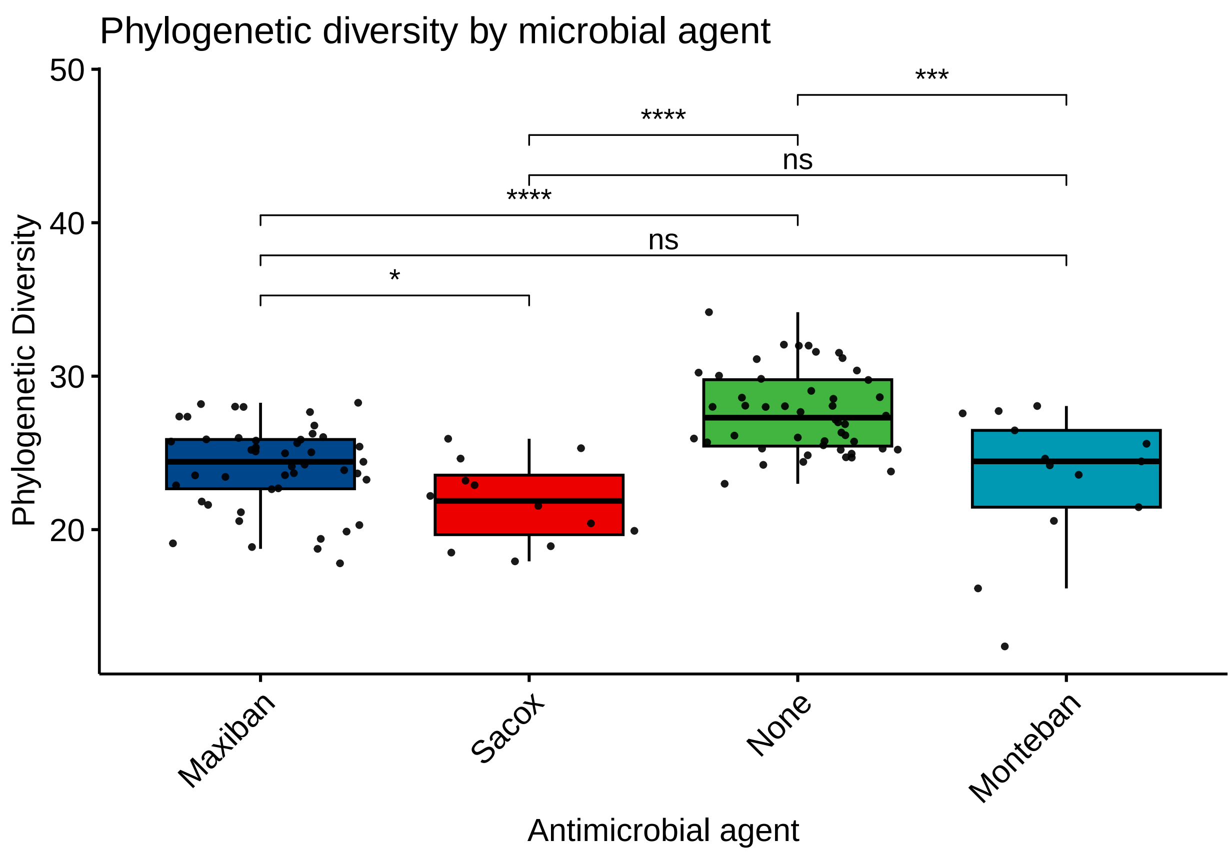
```
##  [1] "sam_name"                    "observed"
##  [3] "chao1"                       "diversity_inverse_simpson"
##  [5] "diversity_gini_simpson"      "diversity_shannon"
##  [7] "diversity_fisher"            "diversity_coverage"
##  [9] "evenness_camargo"            "evenness_pielou"
## [11] "evenness_simpson"            "evenness_evar"
## [13] "evenness_bulla"              "dominance_dbp"
## [15] "dominance_dmn"               "dominance_absolute"
## [17] "dominance_relative"          "dominance_simpson"
## [19] "dominance_core_abundance"    "dominance_gini"
## [21] "rarity_log_modulo_skewness" "rarity_low_abundance"
## [23] "rarity_rare_abundance"       "LibraryNumber"
## [25] "Sample_Unique"               "LibraryName"
## [27] "Farm"                        "Farm2"
## [29] "Stable"                      "FarmRoundStable"
## [31] "Days"                        "Age"
## [33] "Sname"                       "WeightAnimal"
## [35] "Gender"                      "AgeParentStock"
```

```
## [37] "Hatchery"                  "Researcher"
## [39] "AB"                        "Abday"
## [41] "FlockSize"                 "FeedF"
## [43] "FeedType"                  "FeedProducent"
## [45] "Cox"                       "OPG"
## [47] "Cluster"                   "LitterType"
## [49] "Metagenomics"              "Stables"
```

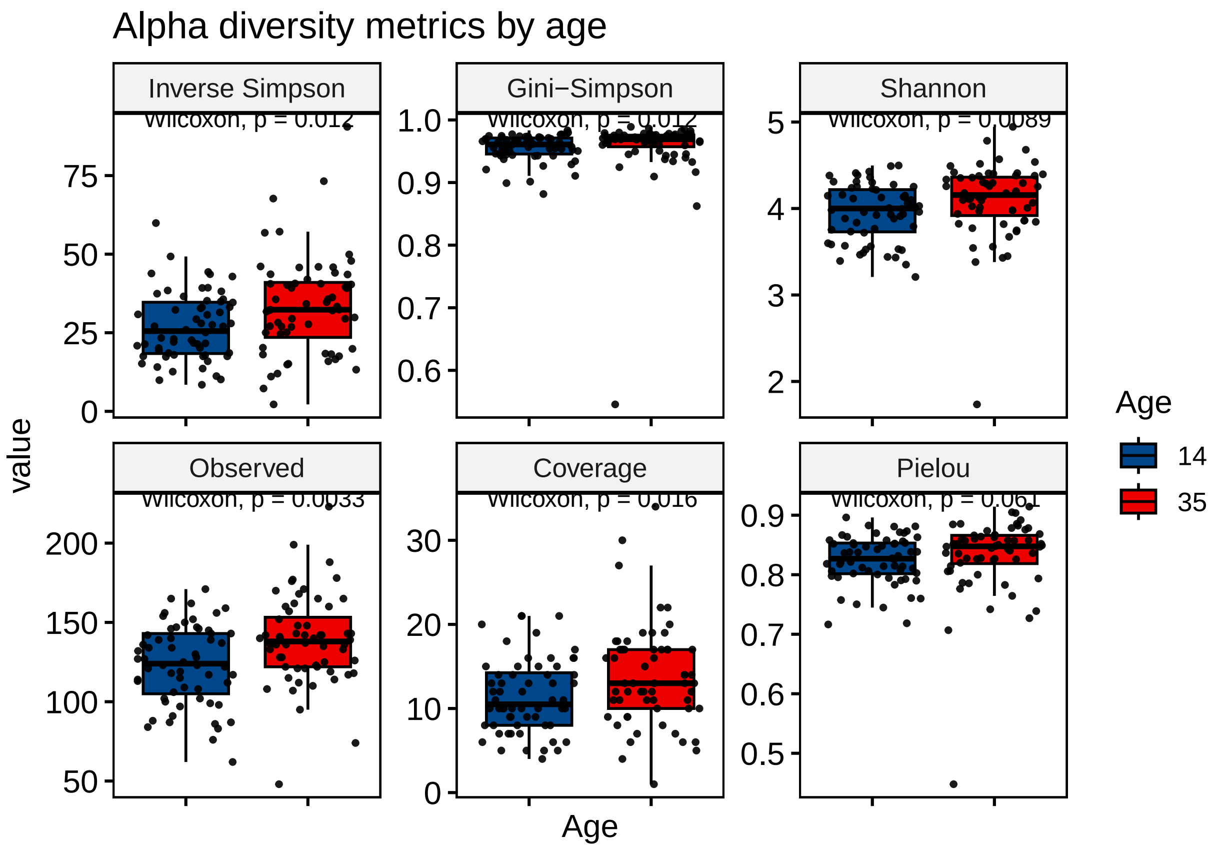
```r
#based on microbial agent
div.df2 <- div.df[, c("Cox", "diversity_inverse_simpson", "diversity_gini_simpson", "diversity_shannon"
colnames(div.df2) <- c("Cox", "Inverse Simpson", "Gini-Simpson", "Shannon", "Observed", "Coverage", "Pi


div_df_melt <- reshape2::melt(div.df2)

lev = c("Maxiban","Sacox","Monteban","None")
L.pairs <- combn(seq_along(lev), 2, simplify = FALSE, FUN = function(i) lev[i])

ggboxplot(div_df_melt, x = "Cox", y = "value",
          fill = "Cox",
          palette = "lancet",
          legend= "right",
          facet.by = "variable",
          scales = "free",
          xlab = "Antimicrobial agent",
          title = "Alpha diversity metrics by microbial agent",
          outlier.shape = NA) +
  rremove("x.text") + stat_compare_means(
    comparisons = L.pairs,
    label = "p.signif"
  ) + geom_jitter(size = 0.7, alpha = 0.9)
```



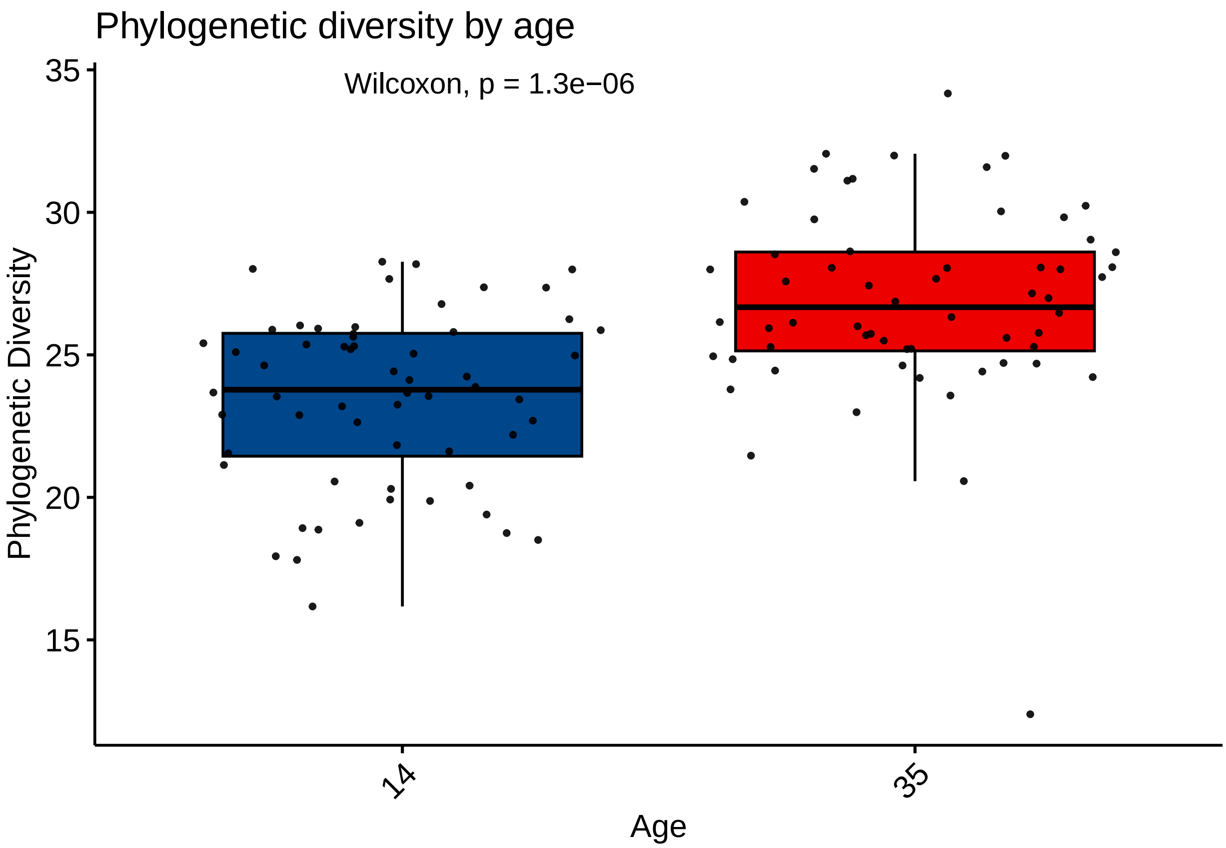

```
df.pd <- pd(t(as.data.frame(subset16S@otu_table)), subset16S@phy_tree,include.root=T) # transposing for
hmp.meta$Phylogenetic_Diversity <- df.pd$PD

ggboxplot(hmp.meta,
          x = "Cox",
          y = "Phylogenetic_Diversity",
          fill = "Cox",
          order = c("Maxiban","Sacox","None","Monteban"),
          palette = "lancet",
          ylab = "Phylogenetic Diversity",
          xlab = "Antimicrobial agent",
          legend = "right",
          title = "Phylogenetic diversity by microbial agent",
          outlier.shape = NA) + rotate_x_text() +
  theme(legend.position="none", axis.text.x=element_text(angle=45,hjust=1,vjust=1,size=12)) +
  stat_compare_means(
    comparisons = L.pairs,
    label = "p.signif"
    ) + geom_jitter(size = 0.7, alpha = 0.9)
```



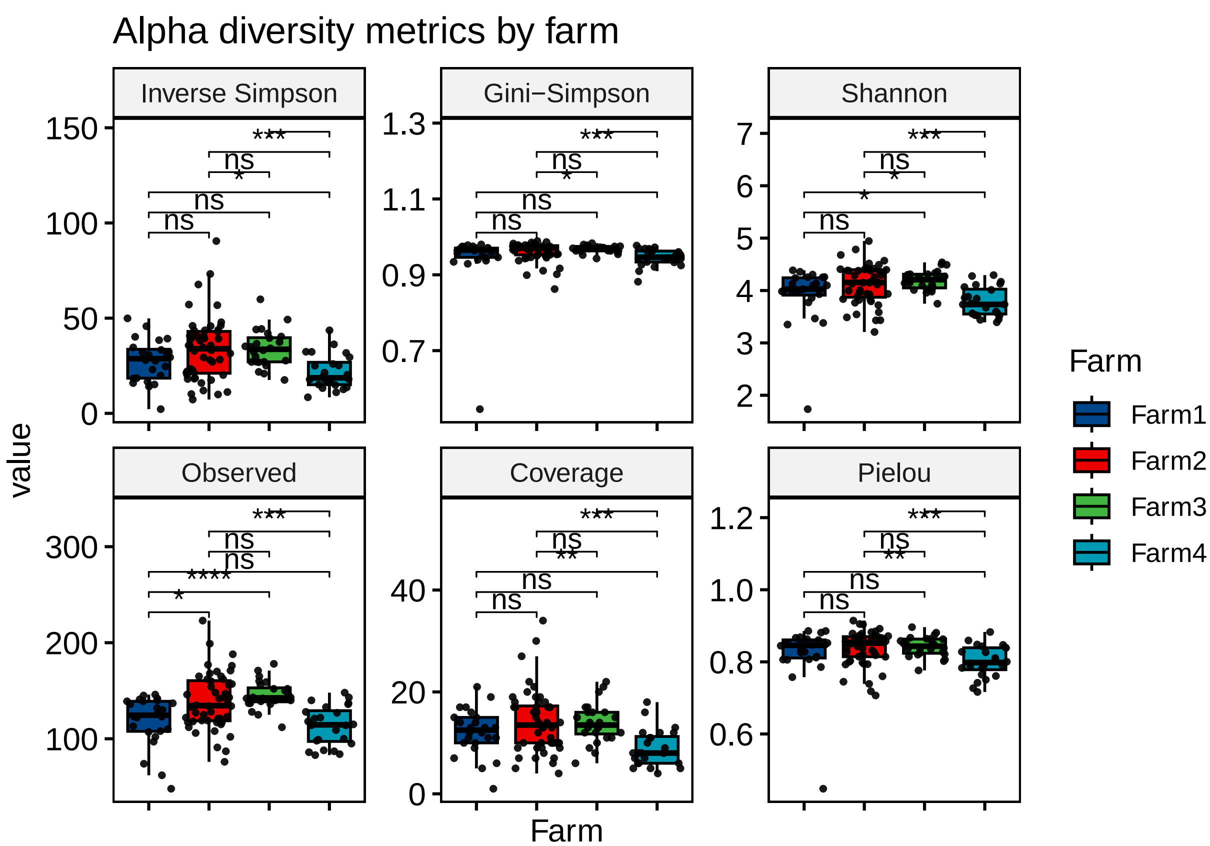

```r
# age / days

div.df2 <- div.df[, c("Age", "diversity_inverse_simpson", "diversity_gini_simpson", "diversity_shannon"
colnames(div.df2) <- c("Age", "Inverse Simpson", "Gini-Simpson", "Shannon", "Observed", "Coverage", "Pi

div.df2$Age = as.factor(div.df2$Age)
div_df_melt <- reshape2::melt(div.df2)

ggboxplot(div_df_melt, x = "Age", y = "value",
          fill = "Age",
          palette = "lancet",
          legend= "right",
          facet.by = "variable",
          scales = "free",
          title = "Alpha diversity metrics by age",
          outlier.shape = NA) +
  rremove("x.text") + stat_compare_means(method = "wilcox.test", size = 3.1) + geom_jitter(size = 0.7, a
```



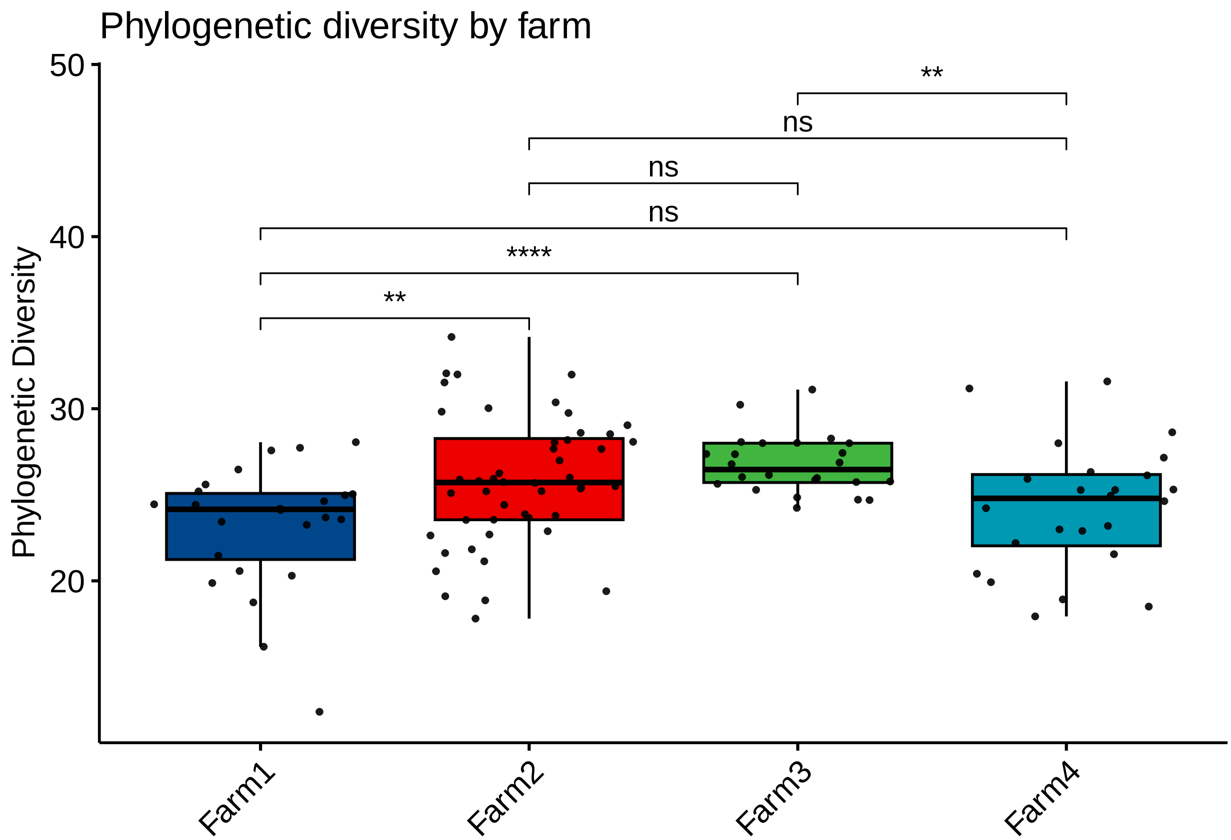

```
ggboxplot(hmp.meta,
          x = "Age",
          y = "Phylogenetic_Diversity",
          fill = "Age",
          palette = "lancet",
          ylab = "Phylogenetic Diversity",
          xlab = "Age",
          legend = "right",
          title = "Phylogenetic diversity by age",
          outlier.shape = NA) + rotate_x_text() +
  theme(legend.position="none", axis.text.x=element_text(angle=45,hjust=1,vjust=1,size=12)) +
  stat_compare_means(paired = TRUE) + geom_jitter(size = 0.7, alpha = 0.9)
```



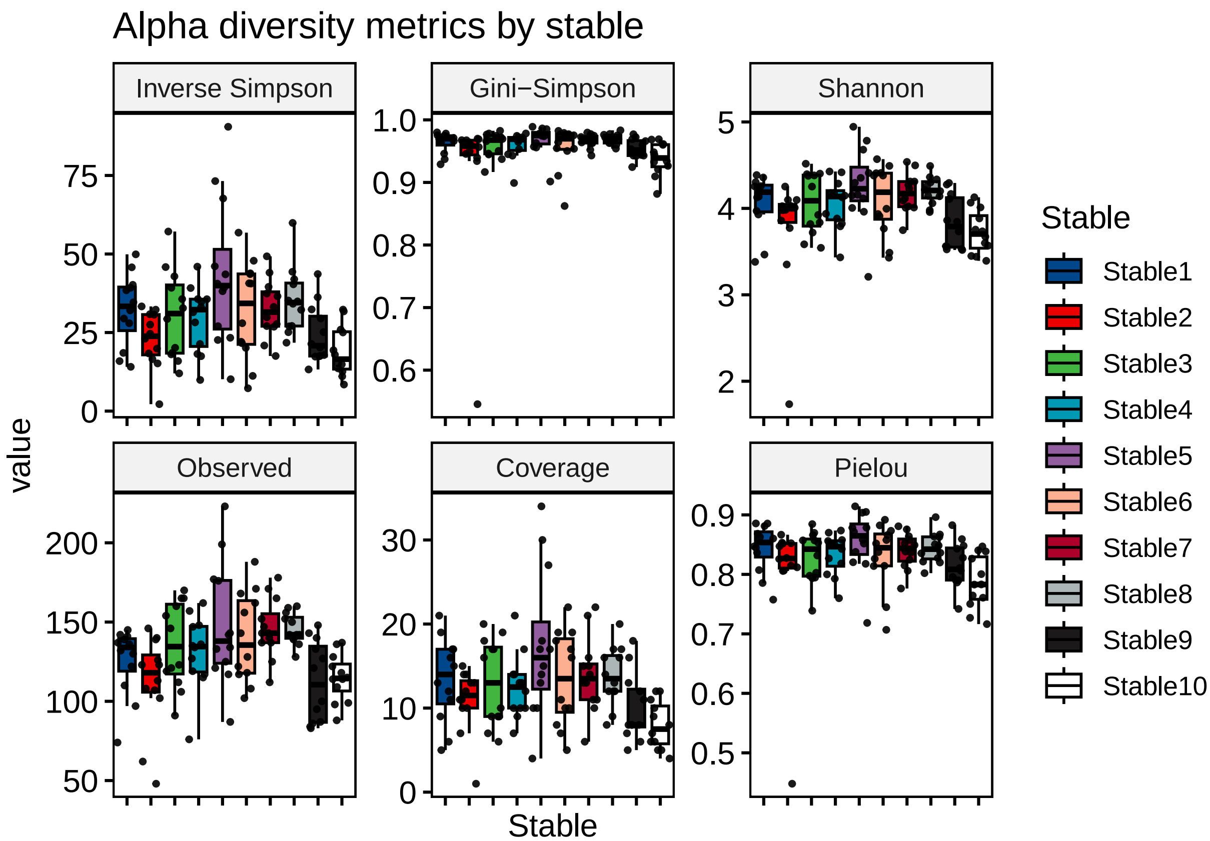

```r
# farms / company

div.df2 <- div.df[, c("Farm2", "diversity_inverse_simpson", "diversity_gini_simpson", "diversity_shanno
colnames(div.df2) <- c("Farm", "Inverse Simpson", "Gini-Simpson", "Shannon", "Observed", "Coverage", "P

div_df_melt <- reshape2::melt(div.df2)

lev = c("Farm1","Farm2","Farm3","Farm4")
L.pairs <- combn(seq_along(lev), 2, simplify = FALSE, FUN = function(i) lev[i])

ggboxplot(div_df_melt, x = "Farm", y = "value",
          fill = "Farm",
          palette = "lancet",
          legend= "right",
          facet.by = "variable",
          scales = "free",
          order = lev,
          title = "Alpha diversity metrics by farm",
          outlier.shape = NA) + rotate_x_text() + rremove("x.text") + stat_compare_means(method = "wilc
                                                                                            comparisons = 
                                                                                            label = "p.sig

          ) + geom_jitter(size = 0.7, alpha = 0.9)
```



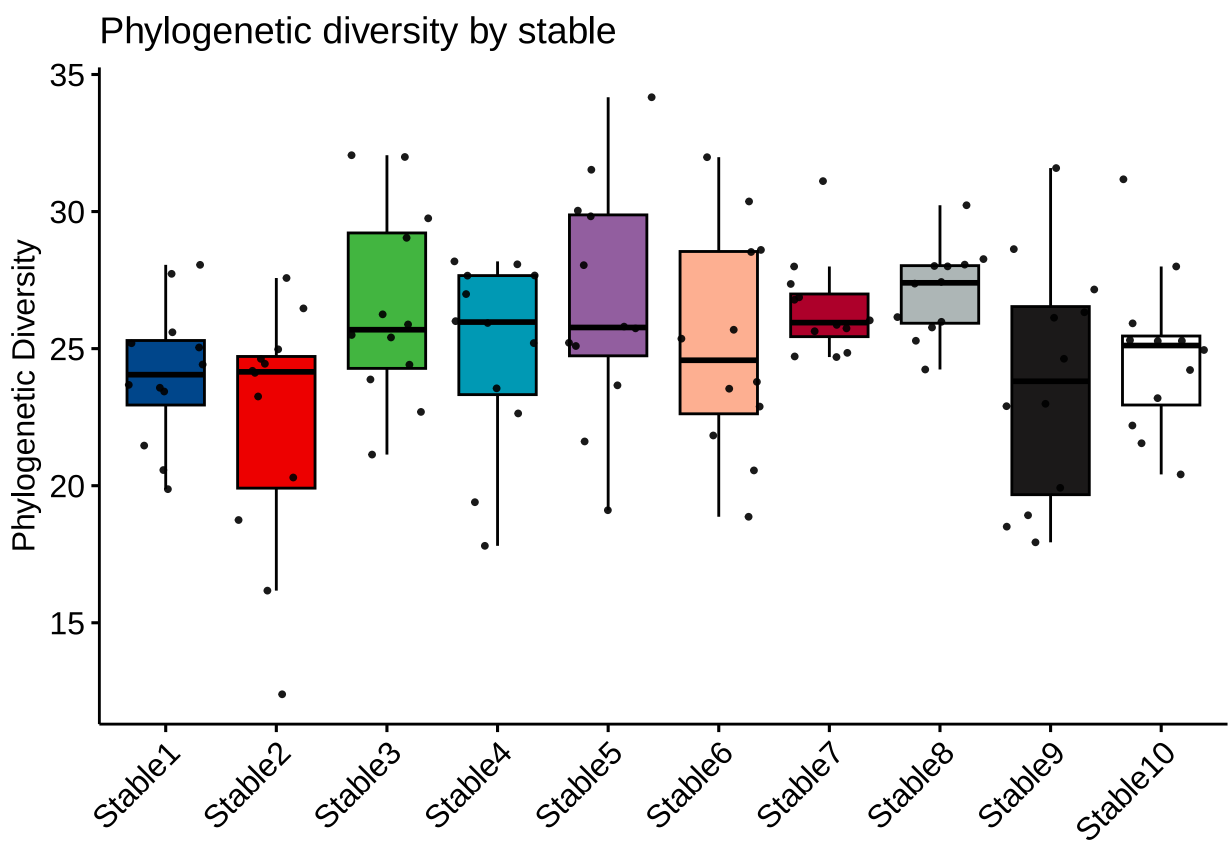

```
ggboxplot(hmp.meta,
          x = "Farm2",
          y = "Phylogenetic_Diversity",
          fill = "Farm2",
          palette = "lancet",
          ylab = "Phylogenetic Diversity",
          xlab = "Farm",
          legend = "right",
          title = "Phylogenetic diversity by farm",
          outlier.shape = NA) + rotate_x_text() +
  theme(legend.position="none", axis.text.x=element_text(angle=45,hjust=1,vjust=1,size=12),  axis.title
  stat_compare_means(
    comparisons = L.pairs,
    label = "p.signif"
  ) + geom_jitter(size = 0.7, alpha = 0.9)
```



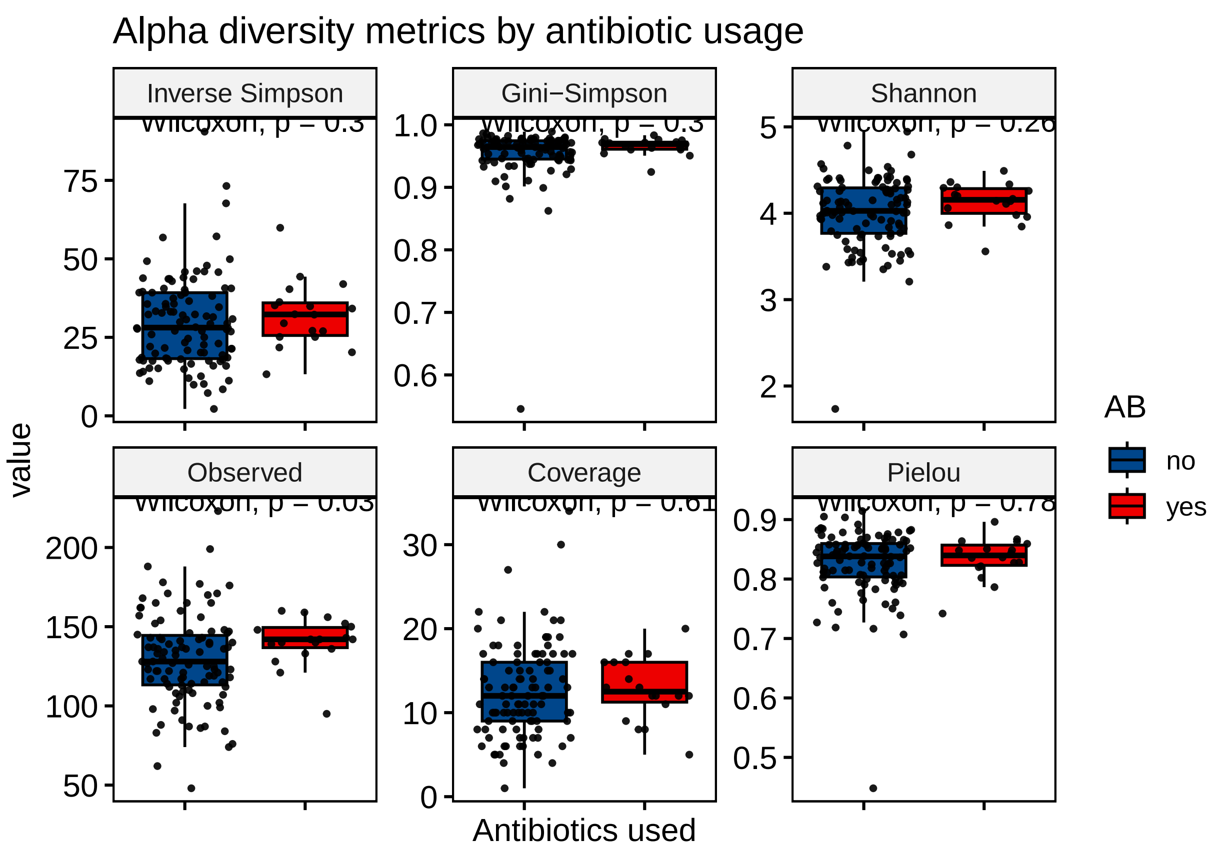

```
# stable

div.df2 <- div.df[, c("Stables", "diversity_inverse_simpson", "diversity_gini_simpson", "diversity_shan
colnames(div.df2) <- c("Stable", "Inverse Simpson", "Gini-Simpson", "Shannon", "Observed", "Coverage",

div_df_melt <- reshape2::melt(div.df2)

lev = c("Stable1","Stable2","Stable3","Stable4","Stable5","Stable6","Stable7","Stable8","Stable9","Stab
L.pairs <- combn(seq_along(lev), 2, simplify = FALSE, FUN = function(i) lev[i])


ggboxplot(div_df_melt, x = "Stable", y = "value",
          fill = "Stable",
          palette = "lancet",
          legend= "right",
          facet.by = "variable",
          scales = "free",
          order = lev,
          title = "Alpha diversity metrics by stable",
          outlier.shape = NA) + rotate_x_text() + rremove("x.text") + geom_jitter(size = 0.7, alpha = 0
```



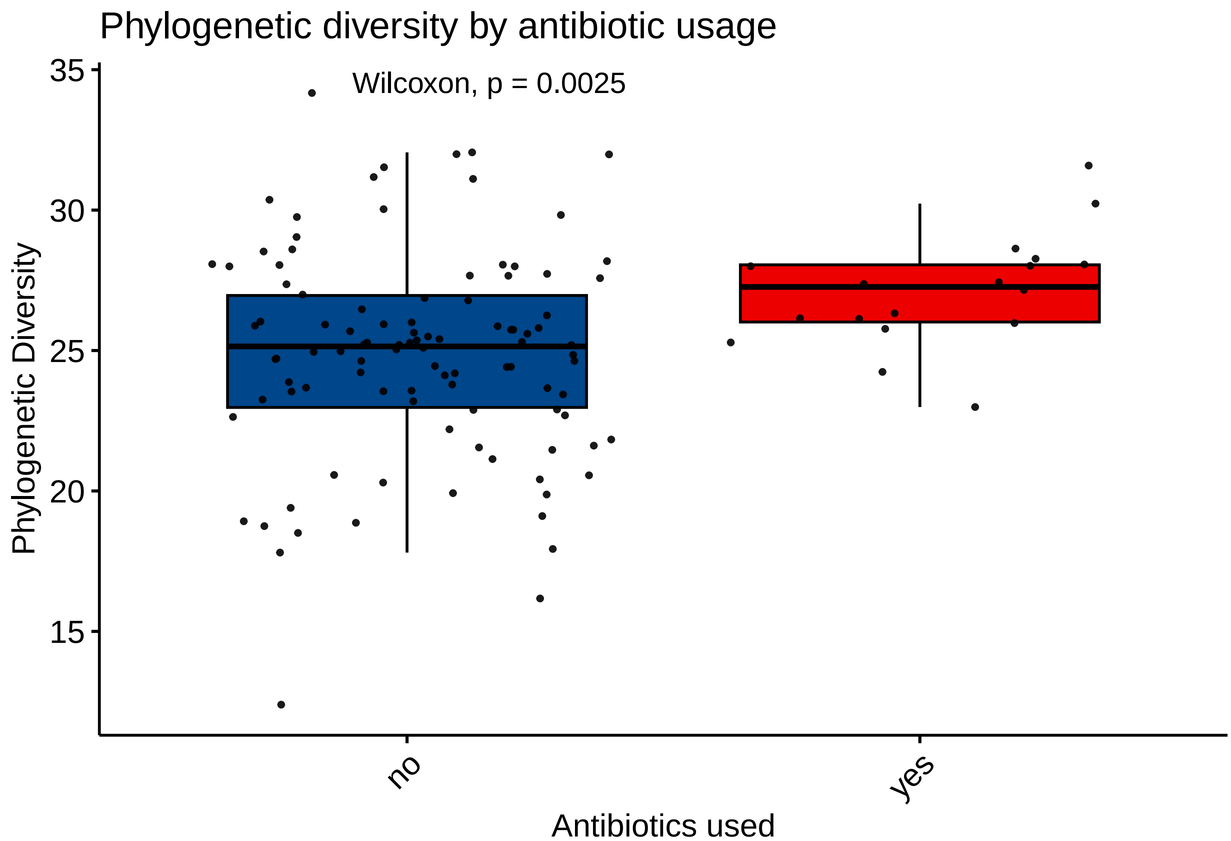

```
ggboxplot(hmp.meta,
          x = "Stables",
          y = "Phylogenetic_Diversity",
          fill = "Stables",
          palette = "lancet",
          ylab = "Phylogenetic Diversity",
          xlab = "Farm",
          legend = "right",
          title = "Phylogenetic diversity by stable",
          outlier.shape = NA) + rotate_x_text() +
  theme(legend.position="none", axis.text.x=element_text(angle=45,hjust=1,vjust=1,size=12),
        axis.title.x = element_blank()) + geom_jitter(size = 0.7, alpha = 0.9)
```



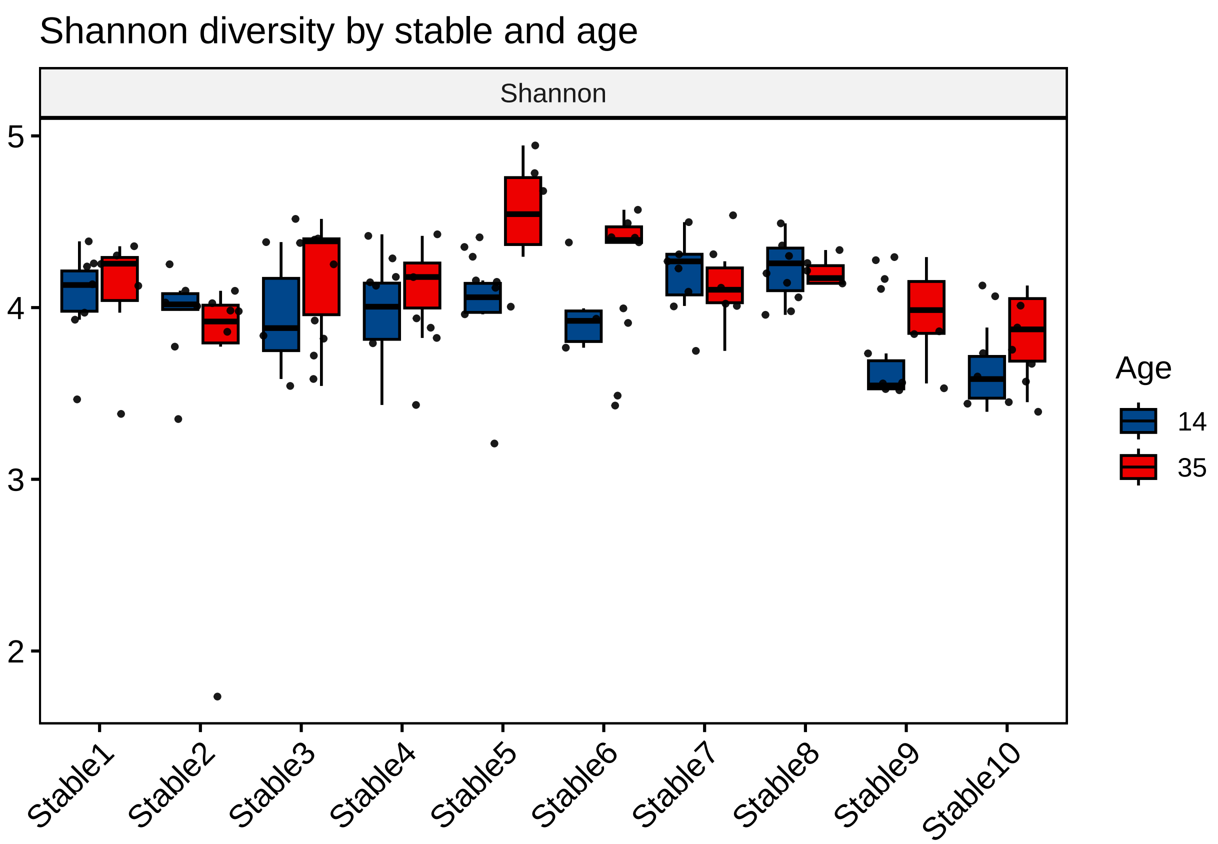

```r
# based on AB

div.df2 <- div.df[, c("AB", "diversity_inverse_simpson", "diversity_gini_simpson", "diversity_shannon",
colnames(div.df2) <- c("AB", "Inverse Simpson", "Gini-Simpson", "Shannon", "Observed", "Coverage", "Pie


div_df_melt <- reshape2::melt(div.df2)

ggboxplot(div_df_melt, x = "AB", y = "value",
          fill = "AB",
          palette = "lancet",
          legend= "right",
          facet.by = "variable",
          scales = "free",
          xlab = "Antibiotics used",
          title = "Alpha diversity metrics by antibiotic usage",
          outlier.shape = NA) +
  rremove("x.text") + stat_compare_means() + geom_jitter(size = 0.7, alpha = 0.9)
```




```
ggboxplot(hmp.meta,
          x = "AB",
          y = "Phylogenetic_Diversity",
          fill = "AB",
          palette = "lancet",
          ylab = "Phylogenetic Diversity",
          xlab = "Antibiotics used",
          legend = "right",
          title = "Phylogenetic diversity by antibiotic usage",
          outlier.shape = NA) + rotate_x_text() +
  theme(legend.position="none", axis.text.x=element_text(angle=45,hjust=1,vjust=1,size=12)) +
  stat_compare_means() + geom_jitter(size = 0.7, alpha = 0.9)
```

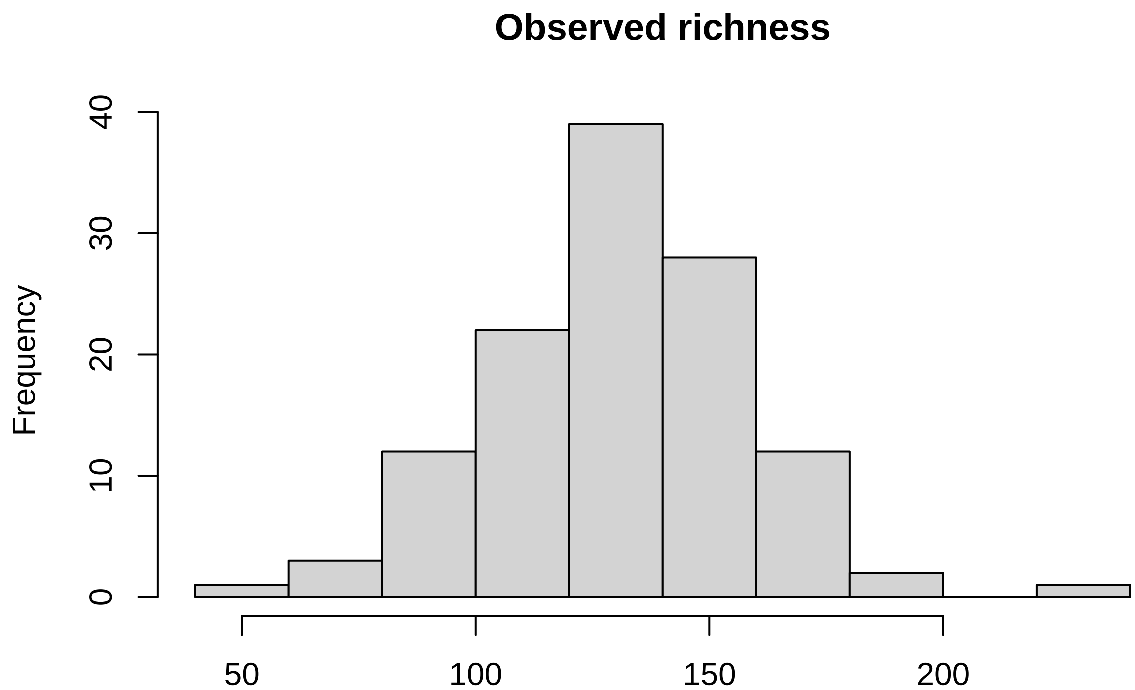



```
# based on stable and age

div.df2 <- div.df[, c("Stables", "Age", "diversity_shannon")]
colnames(div.df2) <- c("Stable", "Age", "Shannon")

div_df_melt <- reshape2::melt(div.df2)

lev = c("Stable1","Stable2","Stable3","Stable4","Stable5","Stable6","Stable7","Stable8","Stable9","Stab

ggboxplot(div_df_melt, x = "Stable", y = "value",
          fill = "Age",
          palette = "lancet",
          legend= "right",
          facet.by = "variable",
          scales = "free",
          order = lev,
          title = "Shannon diversity by stable and age",
          xlab = FALSE,
          ylab = FALSE,
          outlier.shape = NA) + rotate_x_text() +
  theme(axis.text.x=element_text(angle=45,hjust=1,vjust=1,size=12)) + geom_jitter(size = 0.7, alpha = 0
```

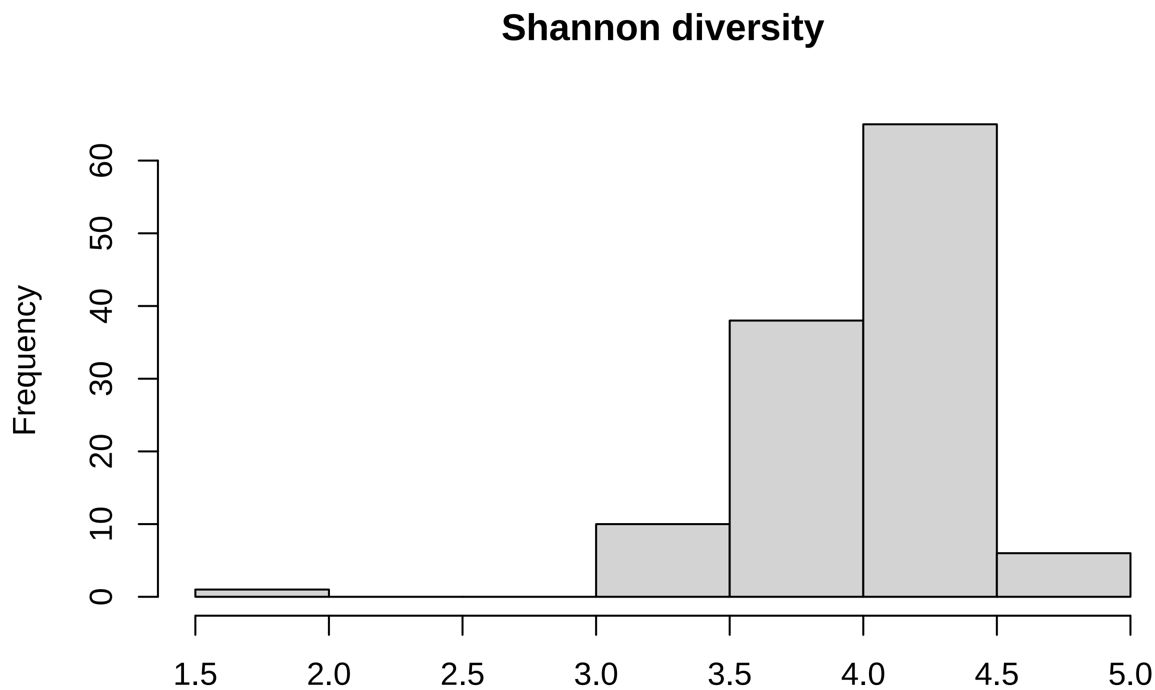


Looking at significance

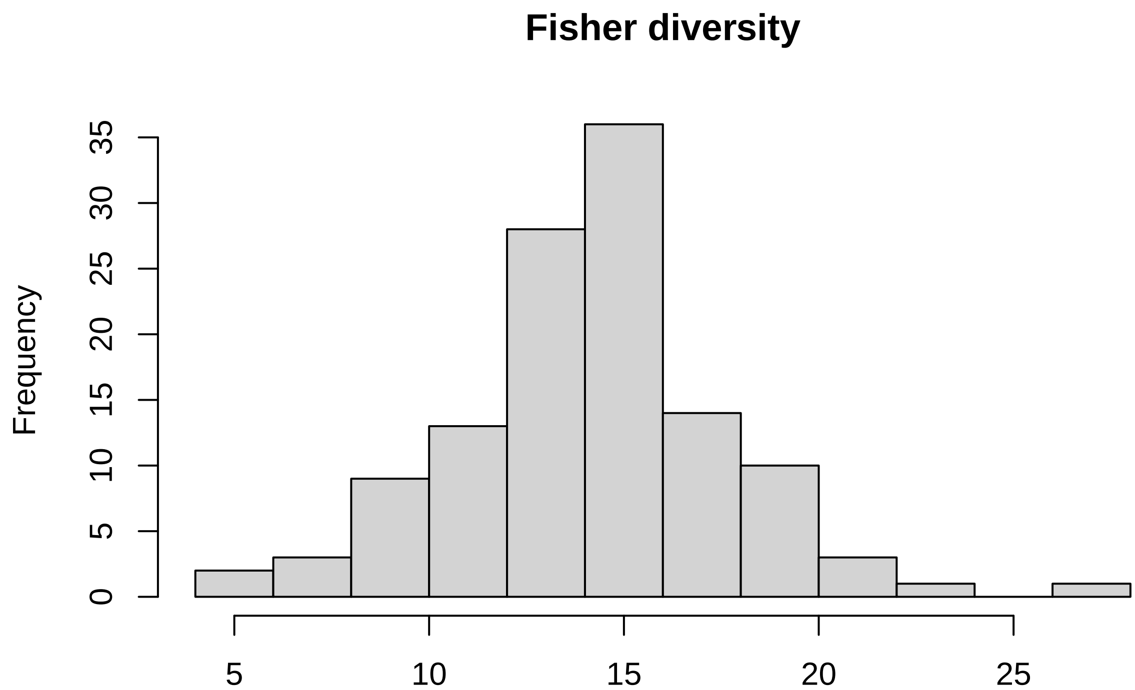
```
# Checking for normality

hist(lib.div$observed, main="Observed richness", xlab="")
```



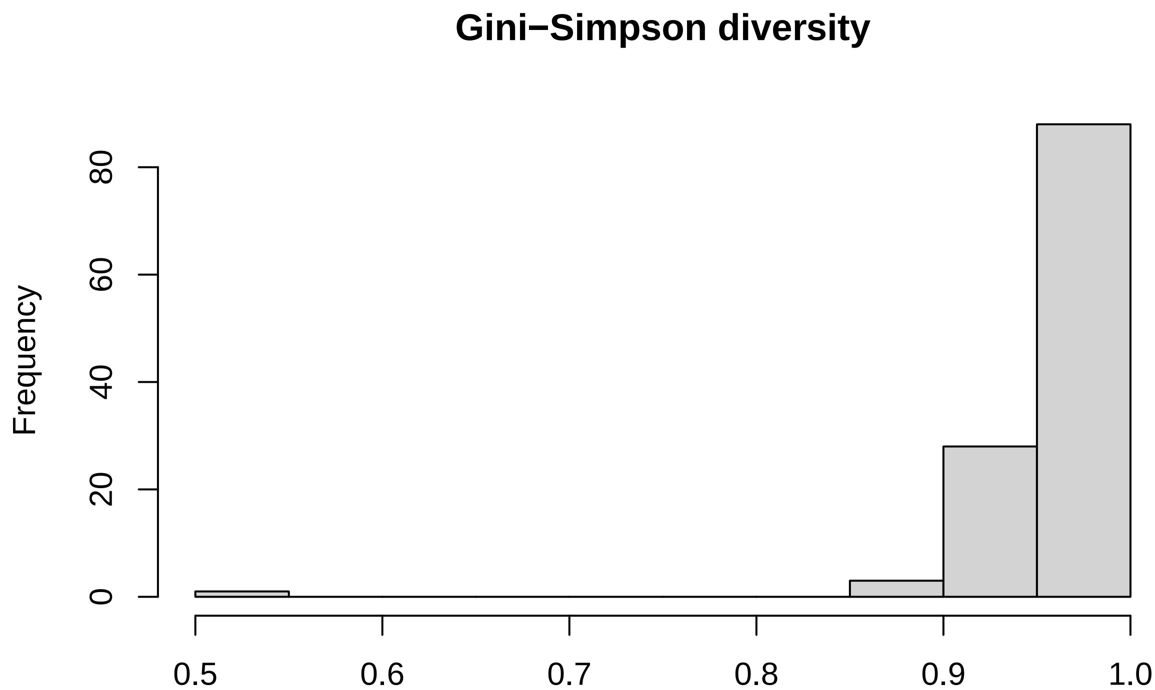

```
hist(lib.div$diversity_shannon, main="Shannon diversity", xlab="")
```



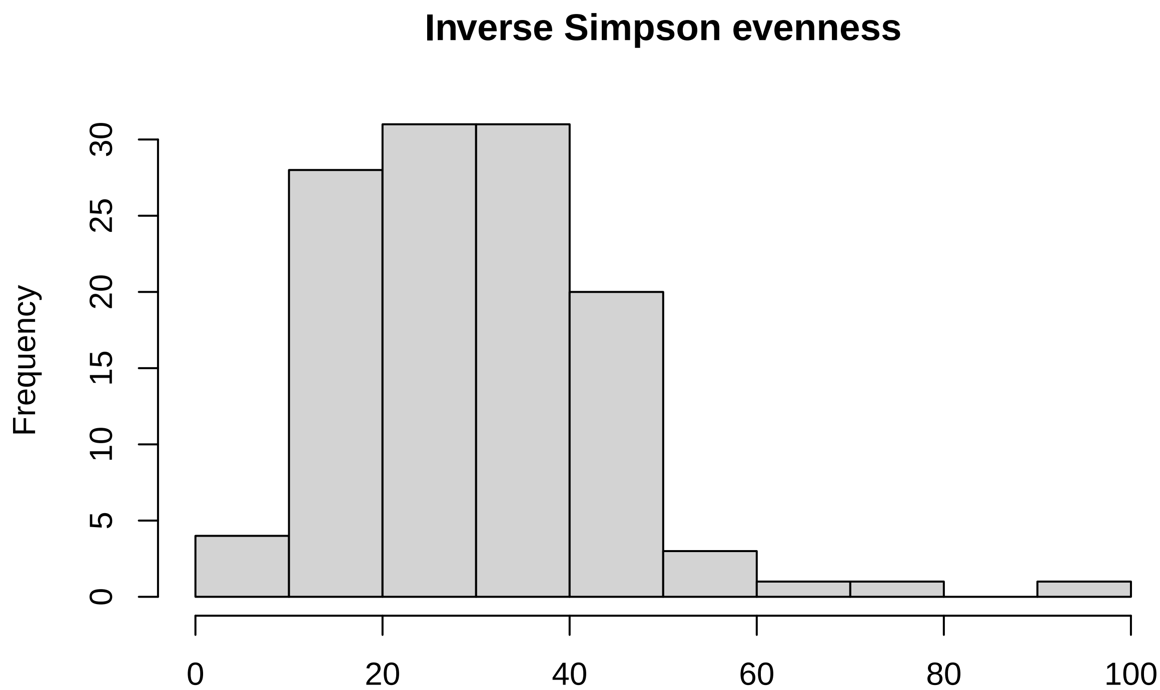

```
hist(lib.div$diversity_fisher, main="Fisher diversity", xlab="")
```



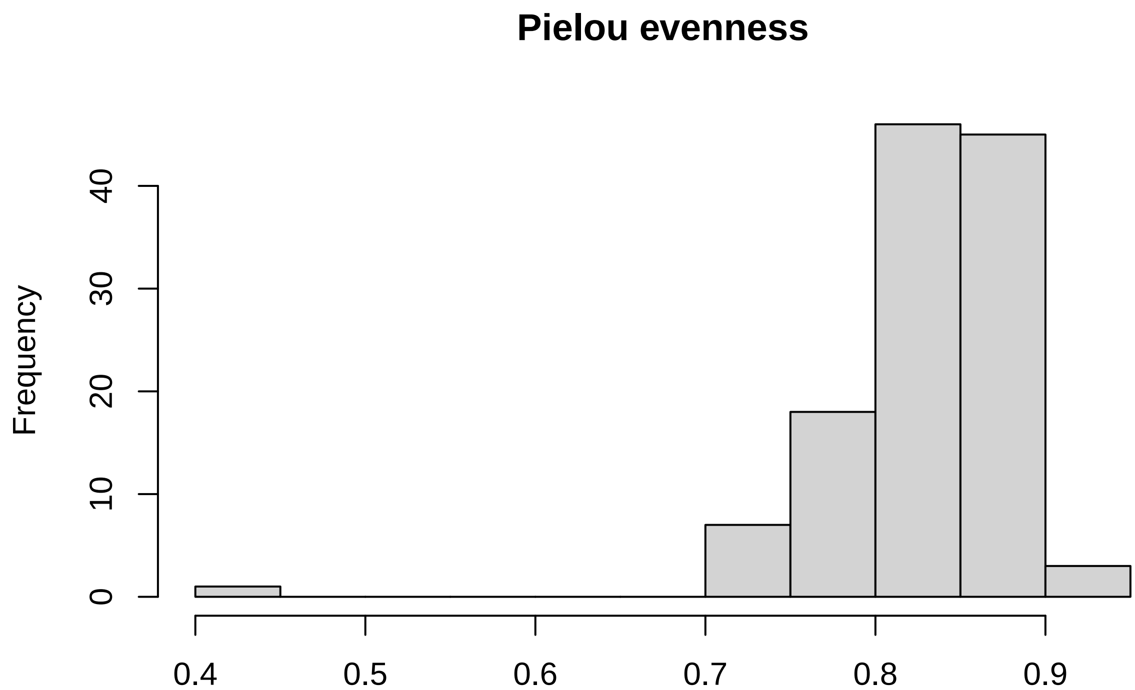

```
hist(lib.div$diversity_gini_simpson, main="Gini-Simpson diversity", xlab="")
```



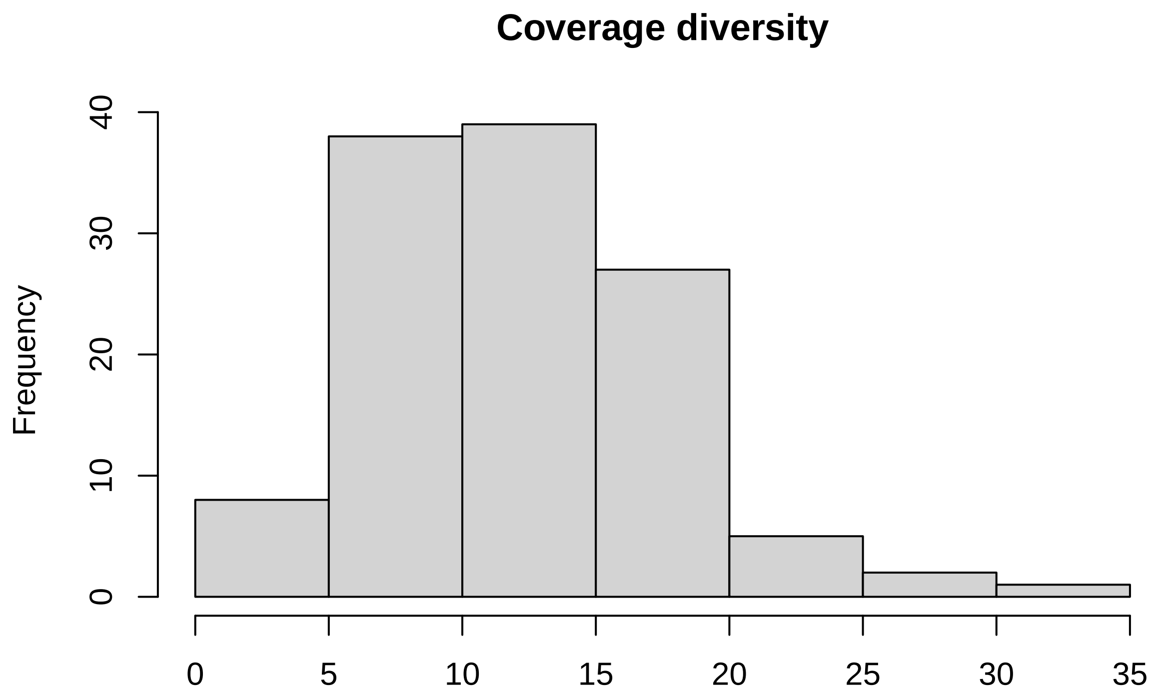

```
hist(lib.div$diversity_inverse_simpson, main="Inverse Simpson evenness", xlab="")
```




```
hist(lib.div$evenness_pielou, main="Pielou evenness", xlab="")
```




```r
hist(lib.div$diversity_coverage, main="Coverage diversity", xlab="")
```



If data is normally distributed we can use ANOVA / t-tests, if not we will use Kruskal-Wallis tests. In this case, the data seems roughly normally distributed for some metrics, we can use Shapiro-Wilk tests to test for normality for individual measures

```
shapiro.test(lib.div$observed) # test deems it  normally distributed p>0,05
```

```
##
##  Shapiro-Wilk normality test
##
## data:  lib.div$observed
## W = 0.98871, p-value = 0.4266
```

```
shapiro.test(lib.div$diversity_shannon) # test deems this measure not normally distributed p<0,05
```

```
##
##  Shapiro-Wilk normality test
##
## data:  lib.div$diversity_shannon
## W = 0.89676, p-value = 1.344e-07
```

```
shapiro.test(lib.div$diversity_fisher) # test deems this measure normally distributed p>0,05
```

```
##
##  Shapiro-Wilk normality test
##
```

```
## data:  lib.div$diversity_fisher
## W = 0.98911, p-value = 0.4585
```

```
shapiro.test(lib.div$diversity_gini_simpson) # test deems this measure not normally distributed p<0,05
```

```
##
##  Shapiro-Wilk normality test
##
## data:  lib.div$diversity_gini_simpson
## W = 0.4334, p-value < 2.2e-16
```

```
shapiro.test(lib.div$diversity_inverse_simpson) # test deems this measure not normally distributed p<0,
```

```
##
##  Shapiro-Wilk normality test
##
## data:  lib.div$diversity_inverse_simpson
## W = 0.9455, p-value = 0.0001025
```

```
shapiro.test(lib.div$evenness_pielou) # test deems this measure not normally distributed p<0,05
```

```
##
##  Shapiro-Wilk normality test
##
## data:  lib.div$evenness_pielou
## W = 0.79225, p-value = 9.689e-12
```

```
shapiro.test(lib.div$diversity_coverage) # test deems this measure not normally distributed p<0,05
```

```
##
##  Shapiro-Wilk normality test
##
## data:  lib.div$diversity_coverage
## W = 0.95673, p-value = 0.000697
```

```
shapiro.test(lib.div$Phylogenetic_Diversity) # test deems this measure normally distributed p>0,05
```

```
##
##  Shapiro-Wilk normality test
##
## data:  lib.div$Phylogenetic_Diversity
## W = 0.9791, p-value = 0.0587
```

```
# Based on shaprio-wilk tests we will assume normality for some measures
# The variables that we are interested in are the Age, which Farm the samples are from, and whether ant

# We will run ANOVAs for the normally distributed variables

# Age

# Normally distributed with only 2 levels, so we can use t-tests :

t.test(lib.div$observed ~ sample_data(subset16S)$Age) # significant
```

```
##
##  Welch Two Sample t-test
##
## data:  lib.div$observed by sample_data(subset16S)$Age
## t = -3.2512, df = 116.43, p-value = 0.001503
## alternative hypothesis: true difference in means between group 14 and group 35 is not equal to 0
## 95 percent confidence interval:
##  -25.371419  -6.161914
## sample estimates:
## mean in group 14 mean in group 35
##         123.1833         138.9500
```

```
t.test(lib.div$diversity_fisher ~ sample_data(subset16S)$Age)  # significant
```

```
##
##  Welch Two Sample t-test
##
## data:  lib.div$diversity_fisher by sample_data(subset16S)$Age
## t = -3.7527, df = 117.44, p-value = 0.0002734
## alternative hypothesis: true difference in means between group 14 and group 35 is not equal to 0
## 95 percent confidence interval:
##  -3.491963 -1.079515
## sample estimates:
## mean in group 14 mean in group 35
##         13.01596         15.30170
```

```
t.test(lib.div$Phylogenetic_Diversity ~ sample_data(subset16S)$Age)  # significant
```

```
##
##  Welch Two Sample t-test
##
## data:  lib.div$Phylogenetic_Diversity by sample_data(subset16S)$Age
## t = -5.8275, df = 116.62, p-value = 5.097e-08
## alternative hypothesis: true difference in means between group 14 and group 35 is not equal to 0
## 95 percent confidence interval:
##  -4.565813 -2.249550
## sample estimates:
## mean in group 14 mean in group 35
##         23.46607         26.87375
```

```
# Non-normally distributed

wilcox.test(lib.div$diversity_shannon ~ sample_data(subset16S)$Age) # shannon diversity seems to signif
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$diversity_shannon by sample_data(subset16S)$Age
## W = 1301, p-value = 0.008885
## alternative hypothesis: true location shift is not equal to 0
```

```r
wilcox.test(lib.div$diversity_gini_simpson ~ sample_data(subset16S)$Age)  # significant
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$diversity_gini_simpson by sample_data(subset16S)$Age
## W = 1323, p-value = 0.01239
## alternative hypothesis: true location shift is not equal to 0
```

```r
wilcox.test(lib.div$diversity_inverse_simpson ~ sample_data(subset16S)$Age)  # significant
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$diversity_inverse_simpson by sample_data(subset16S)$Age
## W = 1323, p-value = 0.01239
## alternative hypothesis: true location shift is not equal to 0
```

```r
wilcox.test(lib.div$evenness_pielou ~ sample_data(subset16S)$Age)  # not significant
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$evenness_pielou by sample_data(subset16S)$Age
## W = 1443, p-value = 0.06133
## alternative hypothesis: true location shift is not equal to 0
```

```r
wilcox.test(lib.div$diversity_coverage ~ sample_data(subset16S)$Age)  # significant
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$diversity_coverage by sample_data(subset16S)$Age
## W = 1340.5, p-value = 0.01577
## alternative hypothesis: true location shift is not equal to 0
```

```r
# For age, the groups seems significantly different in all metrics except pielou evenness.

# Antibiotics

t.test(lib.div$observed ~ sample_data(subset16S)$AB) # significant
```

```
##
##  Welch Two Sample t-test
##
## data:  lib.div$observed by sample_data(subset16S)$AB
## t = -2.3721, df = 42.794, p-value = 0.02225
## alternative hypothesis: true difference in means between group no and group yes is not equal to 0
## 95 percent confidence interval:
##  -20.17172  -1.63220
```

```
## sample estimates:
##  mean in group no mean in group yes
##          129.4314          140.3333
```

```r
t.test(lib.div$diversity_fisher ~ sample_data(subset16S)$AB) # significant
```

```
##
##  Welch Two Sample t-test
##
## data:  lib.div$diversity_fisher by sample_data(subset16S)$AB
## t = -2.0857, df = 44.774, p-value = 0.04273
## alternative hypothesis: true difference in means between group no and group yes is not equal to 0
## 95 percent confidence interval:
##  -2.3593692 -0.0410508
## sample estimates:
##  mean in group no mean in group yes
##          13.97879          15.17900
```

```r
t.test(lib.div$Phylogenetic_Diversity ~ sample_data(subset16S)$AB)  # significant
```

```
##
##  Welch Two Sample t-test
##
## data:  lib.div$Phylogenetic_Diversity by sample_data(subset16S)$AB
## t = -3.7313, df = 40.877, p-value = 0.0005798
## alternative hypothesis: true difference in means between group no and group yes is not equal to 0
## 95 percent confidence interval:
##  -3.481642 -1.036191
## sample estimates:
##  mean in group no mean in group yes
##          24.83107          27.08999
```

```r
# Non-normally distributed

wilcox.test(lib.div$diversity_shannon ~ sample_data(subset16S)$AB) # shannon diversity does not seem to
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$diversity_shannon by sample_data(subset16S)$AB
## W = 765, p-value = 0.2624
## alternative hypothesis: true location shift is not equal to 0
```

```r
wilcox.test(lib.div$diversity_gini_simpson ~ sample_data(subset16S)$AB) # not significant
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$diversity_gini_simpson by sample_data(subset16S)$AB
## W = 776, p-value = 0.2984
## alternative hypothesis: true location shift is not equal to 0
```

```r
wilcox.test(lib.div$diversity_inverse_simpson ~ sample_data(subset16S)$AB) # not significant
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$diversity_inverse_simpson by sample_data(subset16S)$AB
## W = 776, p-value = 0.2984
## alternative hypothesis: true location shift is not equal to 0
```

```r
wilcox.test(lib.div$evenness_pielou ~ sample_data(subset16S)$AB) # not significant
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$evenness_pielou by sample_data(subset16S)$AB
## W = 879, p-value = 0.7772
## alternative hypothesis: true location shift is not equal to 0
```

```r
wilcox.test(lib.div$diversity_coverage ~ sample_data(subset16S)$AB) # not significant
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  lib.div$diversity_coverage by sample_data(subset16S)$AB
## W = 848, p-value = 0.6088
## alternative hypothesis: true location shift is not equal to 0
```

```r
# used the following functions to get means and sd per variable and alpha diversity metric
#lib.div.ab = lib.div
#lib.div.ab$AB = sample_data(subset16S)$AB
#aggregate(lib.div.ab$observed, list(lib.div.ab$AB), FUN=mean)
#aggregate(lib.div.ab$observed, list(lib.div.ab$AB), FUN=sd)


# AB does not seem to significantly differ in their alpha diversities except for observed, PD and fishe

# Farm has more than 2 levels, so we will use ANOVAs for normally distributed metrics

aov.observed.farm = aov(lib.div$observed ~ sample_data(subset16S)$Farm2)
summary(aov.observed.farm)
```

```
##                               Df Sum Sq Mean Sq F value   Pr(>F)
## sample_data(subset16S)$Farm2   3  19238    6413   10.41 4.07e-06 ***
## Residuals                    116  71473     616
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
TukeyHSD(aov.observed.farm) # only not significant between 1 and 4 and 3 and 2
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = lib.div$observed ~ sample_data(subset16S)$Farm2)
##
## $`sample_data(subset16S)$Farm2`
##                 diff        lwr        upr     p adj
## Farm2-Farm1  20.4375   4.261634  36.613366 0.0070916
## Farm3-Farm1  27.2500   8.571718  45.928282 0.0012984
## Farm4-Farm1  -4.8750 -23.553282  13.803282 0.9043806
## Farm3-Farm2   6.8125  -9.363366  22.988366 0.6915866
## Farm4-Farm2 -25.3125 -41.488366  -9.136634 0.0004785
## Farm4-Farm3 -32.1250 -50.803282 -13.446718 0.0001014
```

```
aov.fisher.farm = aov(lib.div$diversity_fisher ~ sample_data(subset16S)$Farm2)
summary(aov.fisher.farm)
```

```
##                               Df Sum Sq Mean Sq F value  Pr(>F)
## sample_data(subset16S)$Farm2   3  294.8   98.27     9.7 9.2e-06 ***
## Residuals                    116 1175.2   10.13
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
TukeyHSD(aov.fisher.farm) # only not significant between 1 and 4 and 3 and 2
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = lib.div$diversity_fisher ~ sample_data(subset16S)$Farm2)
##
## $`sample_data(subset16S)$Farm2`
##                   diff        lwr       upr     p adj
## Farm2-Farm1  2.4636185  0.3893902  4.537847 0.0129624
## Farm3-Farm1  3.0034387  0.6083262  5.398551 0.0076605
## Farm4-Farm1 -0.9432080 -3.3383205  1.451905 0.7342758
## Farm3-Farm2  0.5398202 -1.5344081  2.614048 0.9051069
## Farm4-Farm2 -3.4068265 -5.4810547 -1.332598 0.0002229
## Farm4-Farm3 -3.9466467 -6.3417592 -1.551534 0.0002113
```

```
# Non-normally distributed

kruskal.test(lib.div$diversity_shannon ~ sample_data(subset16S)$Farm2) # shannon diversity seems to sig
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  lib.div$diversity_shannon by sample_data(subset16S)$Farm2
## Kruskal-Wallis chi-squared = 21.53, df = 3, p-value = 8.171e-05
```

```
pairwise.wilcox.test(lib.div$diversity_shannon, sample_data(subset16S)$Farm2, p.adjust.method="fdr") #
```

```
##
##  Pairwise comparisons using Wilcoxon rank sum exact test
##
## data:  lib.div$diversity_shannon and sample_data(subset16S)$Farm2
##
##       Farm1   Farm2   Farm3
## Farm2 0.14005 -       -
## Farm3 0.03874 0.57297 -
## Farm4 0.04790 0.00047 2e-05
##
## P value adjustment method: fdr
```

```
kruskal.test(lib.div$diversity_gini_simpson ~ sample_data(subset16S)$Farm2) # significant
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  lib.div$diversity_gini_simpson by sample_data(subset16S)$Farm2
## Kruskal-Wallis chi-squared = 17.336, df = 3, p-value = 0.0006028
```

```
pairwise.wilcox.test(lib.div$diversity_gini_simpson, sample_data(subset16S)$Farm2, p.adjust.method="fdr
```

```
##
##  Pairwise comparisons using Wilcoxon rank sum exact test
##
## data:  lib.div$diversity_gini_simpson and sample_data(subset16S)$Farm2
##
##       Farm1   Farm2   Farm3
## Farm2 0.15047 -       -
## Farm3 0.09692 0.78047 -
## Farm4 0.08732 0.00256 0.00015
##
## P value adjustment method: fdr
```

```
kruskal.test(lib.div$diversity_inverse_simpson ~ sample_data(subset16S)$Farm2) # not significant
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  lib.div$diversity_inverse_simpson by sample_data(subset16S)$Farm2
## Kruskal-Wallis chi-squared = 17.336, df = 3, p-value = 0.0006028
```

```
pairwise.wilcox.test(lib.div$diversity_inverse_simpson, sample_data(subset16S)$Farm2, p.adjust.method="
```

```
##
##  Pairwise comparisons using Wilcoxon rank sum exact test
##
## data:  lib.div$diversity_inverse_simpson and sample_data(subset16S)$Farm2
##
##       Farm1   Farm2   Farm3
## Farm2 0.15047 -       -
```

```
## Farm3 0.09692 0.78047 -
## Farm4 0.08732 0.00256 0.00015
##
## P value adjustment method: fdr
```

```r
kruskal.test(lib.div$evenness_pielou ~ sample_data(subset16S)$Farm2) # significant
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  lib.div$evenness_pielou by sample_data(subset16S)$Farm2
## Kruskal-Wallis chi-squared = 14.059, df = 3, p-value = 0.002826
```

```r
pairwise.wilcox.test(lib.div$evenness_pielou, sample_data(subset16S)$Farm2, p.adjust.method="fdr") # di
```

```
##
##  Pairwise comparisons using Wilcoxon rank sum exact test
##
## data:  lib.div$evenness_pielou and sample_data(subset16S)$Farm2
##
##       Farm1  Farm2  Farm3
## Farm2 0.8283 -      -
## Farm3 0.8283 0.9197 -
## Farm4 0.0103 0.0028 0.0028
##
## P value adjustment method: fdr
```

```r
# agent also has more than 2 levels, so we will use ANOVAs for normally distributed metrics

aov.observed.agent = aov(lib.div$observed ~ sample_data(subset16S)$Cox)
summary(aov.observed.agent)
```

```
##                              Df Sum Sq Mean Sq F value   Pr(>F)
## sample_data(subset16S)$Cox   3  24998    8333   14.71 3.52e-08 ***
## Residuals                  116  65714     566
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
TukeyHSD(aov.observed.agent) # only not significant between sacox and monteban
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = lib.div$observed ~ sample_data(subset16S)$Cox)
##
## $`sample_data(subset16S)$Cox`
##                       diff        lwr        upr     p adj
## Monteban-Maxiban -18.34043 -37.782360   1.101509 0.0719535
## None-Maxiban      14.30541   1.573992  27.036824 0.0210505
## Sacox-Maxiban    -30.09043 -50.156892 -10.023959 0.0008908
## None-Monteban     32.64583  13.247828  52.043839 0.0001481
## Sacox-Monteban   -11.75000 -36.586601  13.086601 0.6071257
## Sacox-None       -44.39583 -64.419741 -24.371926 0.0000004
```

```
aov.fisher.agent = aov(lib.div$diversity_fisher ~ sample_data(subset16S)$Cox)
summary(aov.fisher.agent)
```

```
##                              Df Sum Sq Mean Sq F value   Pr(>F)    
## sample_data(subset16S)$Cox   3  443.3  147.75   16.69 4.42e-09 ***
## Residuals                  116 1026.8    8.85                     
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
TukeyHSD(aov.fisher.agent) # only not significant maxiban & monteban and sacox & monteban
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
## 
## Fit: aov(formula = lib.div$diversity_fisher ~ sample_data(subset16S)$Cox)
## 
## $`sample_data(subset16S)$Cox`
##                       diff        lwr        upr     p adj
## Monteban-Maxiban -1.947259 -4.3775075  0.4829893 0.1629193
## None-Maxiban      2.025225  0.4337933  3.6166559 0.0065804
## Sacox-Maxiban    -4.096756 -6.6050714 -1.5884411 0.0002443
## None-Monteban     3.972484  1.5477264  6.3972410 0.0002324
## Sacox-Monteban   -2.149497 -5.2540807  0.9550864 0.2763516
## Sacox-None       -6.121981 -8.6249761 -3.6189855 0.0000000
```

```
# Non-normally distributed

kruskal.test(lib.div$diversity_shannon ~ sample_data(subset16S)$Cox) # shannon diversity seems to signi
```

```
## 
##  Kruskal-Wallis rank sum test
## 
## data:  lib.div$diversity_shannon by sample_data(subset16S)$Cox
## Kruskal-Wallis chi-squared = 20.995, df = 3, p-value = 0.0001056
```

```
pairwise.wilcox.test(lib.div$diversity_shannon, sample_data(subset16S)$Cox, p.adjust.method="fdr") # di
```

```
## 
##  Pairwise comparisons using Wilcoxon rank sum exact test 
## 
## data:  lib.div$diversity_shannon and sample_data(subset16S)$Cox 
## 
##          Maxiban Monteban None   
## Monteban 0.31038 -        -      
## None     0.09625 0.06237  -      
## Sacox    0.00031 0.10411  8.1e-05
## 
## P value adjustment method: fdr
```

```r
kruskal.test(lib.div$diversity_gini_simpson ~ sample_data(subset16S)$Cox) # significant
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  lib.div$diversity_gini_simpson by sample_data(subset16S)$Cox
## Kruskal-Wallis chi-squared = 15.296, df = 3, p-value = 0.00158
```

```r
pairwise.wilcox.test(lib.div$diversity_gini_simpson, sample_data(subset16S)$Cox, p.adjust.method="fdr")
```

```
##
##  Pairwise comparisons using Wilcoxon rank sum exact test
##
## data:  lib.div$diversity_gini_simpson and sample_data(subset16S)$Cox
##
##          Maxiban Monteban None
## Monteban 0.4557  -        -
## None     0.0906  0.1557   -
## Sacox    0.0040  0.2020   0.0035
##
## P value adjustment method: fdr
```

```r
kruskal.test(lib.div$diversity_inverse_simpson ~ sample_data(subset16S)$Cox) # not significant
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  lib.div$diversity_inverse_simpson by sample_data(subset16S)$Cox
## Kruskal-Wallis chi-squared = 15.296, df = 3, p-value = 0.00158
```

```r
pairwise.wilcox.test(lib.div$diversity_inverse_simpson, sample_data(subset16S)$Cox, p.adjust.method="fd
```

```
##
##  Pairwise comparisons using Wilcoxon rank sum exact test
##
## data:  lib.div$diversity_inverse_simpson and sample_data(subset16S)$Cox
##
##          Maxiban Monteban None
## Monteban 0.4557  -        -
## None     0.0906  0.1557   -
## Sacox    0.0040  0.2020   0.0035
##
## P value adjustment method: fdr
```

```r
kruskal.test(lib.div$evenness_pielou ~ sample_data(subset16S)$Cox) # significant
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  lib.div$evenness_pielou by sample_data(subset16S)$Cox
## Kruskal-Wallis chi-squared = 10.984, df = 3, p-value = 0.01181
```

```
pairwise.wilcox.test(lib.div$evenness_pielou, sample_data(subset16S)$Cox, p.adjust.method="fdr") # same
```

```
##
##  Pairwise comparisons using Wilcoxon rank sum exact test
##
## data:  lib.div$evenness_pielou and sample_data(subset16S)$Cox
##
##          Maxiban Monteban None
## Monteban 0.750   -        -
## None     0.377   0.454    -
## Sacox    0.010   0.051    0.010
##
## P value adjustment method: fdr
```

Beta diversity

```
estimate_richness(subset16S) # no singletons
```

```
##        Observed Chao1 se.chao1 ACE se.ACE  Shannon   Simpson InvSimpson
## X2_23       132   132        0 NaN    NaN 4.136003 0.9711196  34.625599
## X2_24       139   139        0 NaN    NaN 4.126936 0.9642492  27.971432
## X2_25        97    97        0 NaN    NaN 3.465461 0.9290117  14.086821
## X2_26       130   130        0 NaN    NaN 3.929347 0.9460238  18.526673
## X2_27       136   136        0 NaN    NaN 4.239237 0.9739942  38.452916
## X2_29       145   145        0 NaN    NaN 4.385673 0.9745243  39.253112
## X2_36       123   123        0 NaN    NaN 4.098432 0.9675785  30.843755
## X2_39       123   123        0 NaN    NaN 3.982521 0.9565922  23.037346
## X2_40       146   146        0 NaN    NaN 4.252383 0.9690197  32.278559
## X2_41       102   102        0 NaN    NaN 4.008183 0.9674078  30.682184
## X2_42       113   113        0 NaN    NaN 4.029328 0.9636649  27.521614
## X2_47       141   141        0 NaN    NaN 4.257202 0.9688112  32.062832
## X2_48        74    74        0 NaN    NaN 3.380875 0.9371476  15.910281
## X2_49       110   110        0 NaN    NaN 3.970268 0.9660476  29.453042
## X2_50       137   137        0 NaN    NaN 4.357221 0.9799604  49.901207
## X2_51       122   122        0 NaN    NaN 4.253943 0.9781493  45.765045
## X2_52       142   142        0 NaN    NaN 4.303497 0.9751186  40.190629
## X2_56       126   126        0 NaN    NaN 4.097594 0.9699867  33.318612
## X2_57        48    48        0 NaN    NaN 1.734529 0.5455967   2.200688
## X2_58       108   108        0 NaN    NaN 3.772379 0.9455148  18.353603
## X2_59       107   107        0 NaN    NaN 3.858977 0.9593703  24.612528
## X2_60       139   139        0 NaN    NaN 3.978746 0.9497115  19.885269
## X2_61       140   140        0 NaN    NaN 4.025627 0.9395879  16.552984
## X4_36       119   119        0 NaN    NaN 3.836459 0.9503957  20.159535
## X4_37        91    91        0 NaN    NaN 3.584282 0.9461311  18.563597
## X4_38       146   146        0 NaN    NaN 4.252073 0.9694887  32.774785
## X4_39       106   106        0 NaN    NaN 3.720320 0.9372538  15.937227
## X4_40       154   154        0 NaN    NaN 4.381358 0.9766794  42.880526
## X4_41       112   112        0 NaN    NaN 3.924462 0.9658913  29.318027
## X4_54       170   170        0 NaN    NaN 4.402081 0.9719656  35.670497
## X4_55       121   121        0 NaN    NaN 3.543604 0.9166889  12.003196
## X4_56       165   165        0 NaN    NaN 4.376416 0.9745189  39.244723
```

```
## X4_57        160   160         0 NaN    NaN 4.395525 0.9781892  45.848768
## X4_65         62    62         0 NaN    NaN 3.350815 0.9340956  15.173499
## X5_39         76    76         0 NaN    NaN 3.432905 0.9428191  17.488352
## X5_40        162   162         0 NaN    NaN 4.426712 0.9697948  33.106899
## X5_41        147   147         0 NaN    NaN 3.792368 0.8991109   9.911873
## X5_54        165   165         0 NaN    NaN 4.516410 0.9825044  57.157274
## X5_55        123   123         0 NaN    NaN 3.819140 0.9446352  18.062019
## X5_59        157   157         0 NaN    NaN 4.417525 0.9782484  45.973571
## X6_36        127   127         0 NaN    NaN 4.147429 0.9719594  35.662588
## X6_37        115   115         0 NaN    NaN 3.882798 0.9531995  21.367304
## X6_38        134   134         0 NaN    NaN 4.127256 0.9682224  31.468693
## X6_54        135   135         0 NaN    NaN 4.178638 0.9719210  35.613788
## X6_55        148   148         0 NaN    NaN 4.286540 0.9744719  39.172460
## X6_56        136   136         0 NaN    NaN 4.177493 0.9711918  34.712361
## X6_57        119   119         0 NaN    NaN 3.823249 0.9450037  18.183044
## X6_58        117   117         0 NaN    NaN 3.937373 0.9645764  28.229778
## X9_16        125   125         0 NaN    NaN 3.961053 0.9558198  22.634587
## X9_17        121   121         0 NaN    NaN 4.115315 0.9737945  38.159910
## X9_18        134   134         0 NaN    NaN 4.005118 0.9571588  23.342017
## X9_19         87    87         0 NaN    NaN 3.208366 0.9014346  10.145551
## X9_21        143   143         0 NaN    NaN 4.158081 0.9629915  27.020836
## X9_22        117   117         0 NaN    NaN 4.149825 0.9745724  39.327320
## X9_34        122   122         0 NaN    NaN 3.910564 0.9502966  20.119340
## X9_35        108   108         0 NaN    NaN 3.487252 0.9107067  11.199048
## X9_36        117   117         0 NaN    NaN 3.935009 0.9537531  21.623091
## X9_37        118   118         0 NaN    NaN 3.995557 0.9642583  27.978554
## X9_38        102   102         0 NaN    NaN 3.766274 0.9546683  22.059594
## X9_39        156   156         0 NaN    NaN 4.409694 0.9771994  43.858458
## X10_1        147   147         0 NaN    NaN 4.022611 0.9520885  20.871823
## X10_2        171   171         0 NaN    NaN 4.310664 0.9698373  33.153575
## X10_3        143   143         0 NaN    NaN 4.227802 0.9726454  36.556920
## X10_4        152   152         0 NaN    NaN 4.310282 0.9732866  37.434357
## X10_7        137   137         0 NaN    NaN 4.009593 0.9630614  27.071976
## X10_8        165   165         0 NaN    NaN 4.497594 0.9797021  49.266232
## X10_10       159   159         0 NaN    NaN 4.300777 0.9715780  35.183966
## X10_11       150   150         0 NaN    NaN 4.490556 0.9833046  59.896830
## X10_12       142   142         0 NaN    NaN 4.214847 0.9713536  34.908339
## X10_13       156   156         0 NaN    NaN 4.361647 0.9774440  44.334088
## X10_14       139   139         0 NaN    NaN 3.957786 0.9540649  21.769848
## X10_15       140   140         0 NaN    NaN 4.059547 0.9601771  25.111174
## X10_19        84    84         0 NaN    NaN 3.525545 0.9423290  17.339745
## X10_20        87    87         0 NaN    NaN 3.530217 0.9429301  17.522359
## X10_21       127   127         0 NaN    NaN 4.276047 0.9770737  43.618080
## X10_22        86    86         0 NaN    NaN 3.518669 0.9428566  17.499831
## X10_25        83    83         0 NaN    NaN 3.562820 0.9439357  17.836654
## X10_26       100   100         0 NaN    NaN 3.732990 0.9532478  21.389377
## X10_28        88    88         0 NaN    NaN 3.754545 0.9614331  25.928982
## X10_29       114   114         0 NaN    NaN 3.393108 0.8816650   8.450584
## X10_30       109   109         0 NaN    NaN 3.568981 0.9265013  13.605679
## X10_33       128   128         0 NaN    NaN 3.883777 0.9483538  19.362526
## X10_34        98    98         0 NaN    NaN 3.440144 0.9207547  12.619050
## X10_35        99    99         0 NaN    NaN 3.598482 0.9442832  17.947893
## X10_39       125   125         0 NaN    NaN 3.747857 0.9430010  17.544153
## X10_40       112   112         0 NaN    NaN 4.006892 0.9627609  26.853519
```

```
## X10_41      140   140         0 NaN    NaN 4.269641 0.9747131  39.546109
## X10_42      143   143         0 NaN    NaN 4.092277 0.9638905  27.693543
## X10_43      178   178         0 NaN    NaN 4.537584 0.9773062  44.064913
## X10_44      137   137         0 NaN    NaN 4.115558 0.9665253  29.873330
## X10_48      160   160         0 NaN    NaN 4.199373 0.9631082  27.106304
## X10_49      142   142         0 NaN    NaN 4.140257 0.9689761  32.233257
## X10_50      128   128         0 NaN    NaN 3.978572 0.9629375  26.981421
## X10_51      152   152         0 NaN    NaN 4.335136 0.9752193  40.354031
## X10_52      136   136         0 NaN    NaN 4.259292 0.9761764  41.975197
## X10_53      142   142         0 NaN    NaN 4.144321 0.9707317  34.166653
## X10_57      140   140         0 NaN    NaN 4.166506 0.9690959  32.358201
## X10_58      121   121         0 NaN    NaN 3.558282 0.9245442  13.252790
## X10_59      148   148         0 NaN    NaN 4.294089 0.9724177  36.255089
## X10_60       95    95         0 NaN    NaN 3.862023 0.9660824  29.483175
## X10_63      143   143         0 NaN    NaN 4.108655 0.9602230  25.140134
## X10_64      133   133         0 NaN    NaN 3.845720 0.9506031  20.244171
## X10_66      137   137         0 NaN    NaN 4.066091 0.9600511  25.031975
## X10_67      118   118         0 NaN    NaN 3.734614 0.9327431  14.868368
## X10_68      114   114         0 NaN    NaN 4.011428 0.9684984  31.744427
## X10_69      115   115         0 NaN    NaN 3.449319 0.9095590  11.056929
## X11_1       136   136         0 NaN    NaN 4.128541 0.9690378  32.297435
## X11_3       122   122         0 NaN    NaN 3.672527 0.9338568  15.118723
## X14_20      177   177         0 NaN    NaN 4.409254 0.9753444  40.558697
## X14_21      142   142         0 NaN    NaN 4.353094 0.9770271  43.529539
## X14_22      133   133         0 NaN    NaN 4.296036 0.9783014  46.086004
## X14_23      199   199         0 NaN    NaN 4.783165 0.9863423  73.218561
## X14_25      176   176         0 NaN    NaN 4.679120 0.9852256  67.684481
## X14_27      223   223         0 NaN    NaN 4.944154 0.9889503  90.500150
## X14_29      168   168         0 NaN    NaN 4.569564 0.9823959  56.804951
## X14_30      188   188         0 NaN    NaN 4.491616 0.9753695  40.600036
## X14_33      162   162         0 NaN    NaN 4.406904 0.9770711  43.613089
## X14_34      128   128         0 NaN    NaN 3.429396 0.8623682   7.265762
## X14_35      171   171         0 NaN    NaN 4.380340 0.9754211  40.685323
## X14_36      143   143         0 NaN    NaN 4.379227 0.9791060  47.860532
##            Fisher
## X2_23  14.163010
## X2_24  14.814971
## X2_25   9.896331
## X2_26  14.190333
## X2_27  15.623575
## X2_29  14.578601
## X2_36  12.941416
## X2_39  13.328383
## X2_40  17.140224
## X2_41  10.996498
## X2_42  12.311257
## X2_47  16.462924
## X2_48   7.588284
## X2_49  11.837343
## X2_50  15.179815
## X2_51  12.413289
## X2_52  15.242362
## X2_56  13.886854
## X2_57   4.609881
```

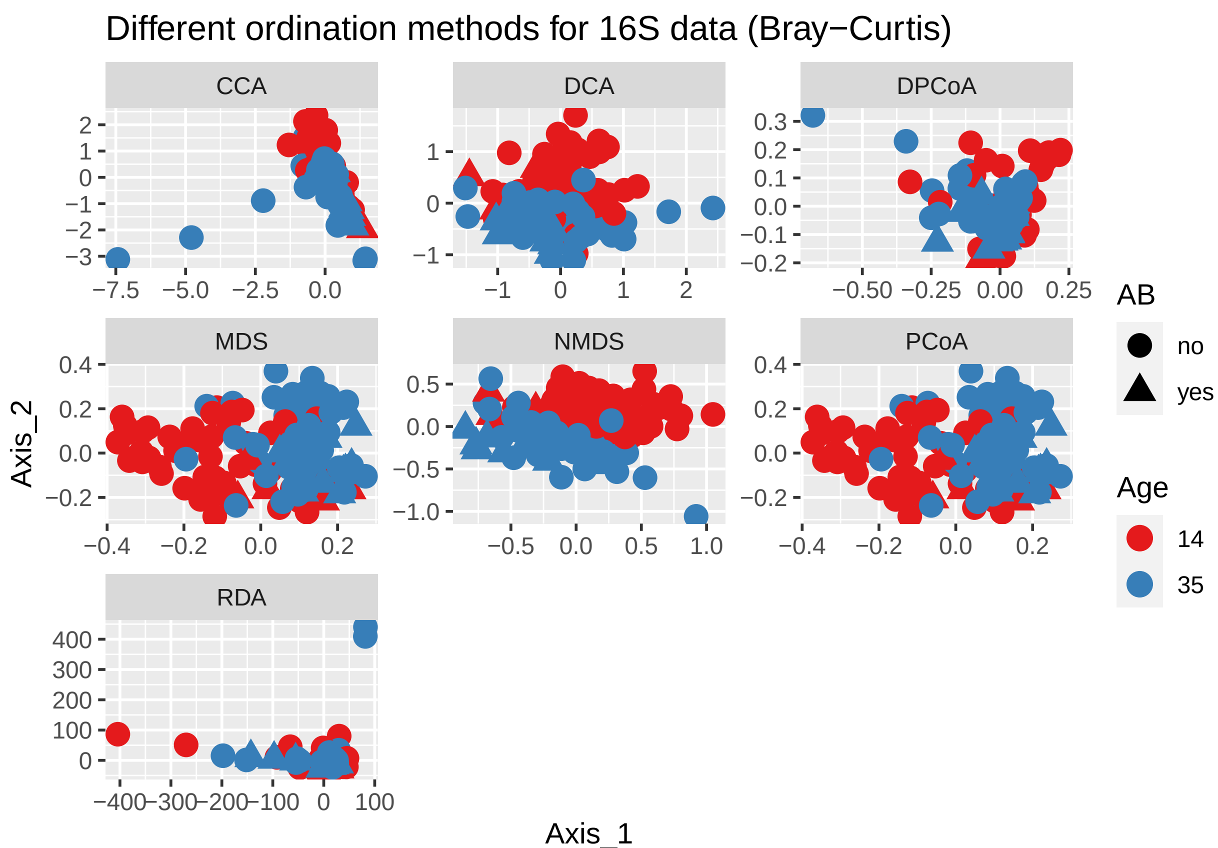
```
## X2_58  11.654290
## X2_59  11.399075
## X2_60  15.023335
## X2_61  15.063981
## X4_36  12.305789
## X4_37   8.716916
## X4_38  15.586719
## X4_39  11.537281
## X4_40  19.831817
## X4_41  12.171287
## X4_54  18.370424
## X4_55  14.841290
## X4_56  17.931372
## X4_57  17.960087
## X4_65   5.925936
## X5_39   7.671534
## X5_40  20.407865
## X5_41  16.292875
## X5_54  18.013456
## X5_55  14.835637
## X5_59  19.333468
## X6_36  12.683630
## X6_37  11.331777
## X6_38  14.095720
## X6_54  14.306480
## X6_55  18.506106
## X6_56  14.640803
## X6_57  13.343276
## X6_58  11.875237
## X9_16  13.450478
## X9_17  12.585239
## X9_18  13.672532
## X9_19   8.444623
## X9_21  15.750868
## X9_22  12.545120
## X9_34  12.464780
## X9_35  11.005212
## X9_36  12.046206
## X9_37  12.196534
## X9_38  10.546501
## X9_39  18.188937
## X10_1  14.801263
## X10_2  17.913932
## X10_3  15.474146
## X10_4  15.608820
## X10_7  15.627062
## X10_8  17.314410
## X10_10 17.070298
## X10_11 16.383901
## X10_12 14.722089
## X10_13 17.686567
## X10_14 14.172646
## X10_15 14.270153
## X10_19  8.022038
```

```
## X10_20  8.517057
## X10_21 12.973489
## X10_22  8.296877
## X10_25  7.848329
## X10_26 10.320954
## X10_28  8.725458
## X10_29 10.934345
## X10_30 10.995780
## X10_33 12.728324
## X10_34  9.333958
## X10_35  9.774689
## X10_39 13.503588
## X10_40 12.889365
## X10_41 15.867978
## X10_42 15.715324
## X10_43 20.904381
## X10_44 15.222496
## X10_48 17.734041
## X10_49 15.451132
## X10_50 13.353367
## X10_51 16.494365
## X10_52 14.412306
## X10_53 15.760869
## X10_57 15.870862
## X10_58 12.927447
## X10_59 17.425828
## X10_60 10.411951
## X10_63 14.552490
## X10_64 14.521762
## X10_66 14.605380
## X10_67 13.300472
## X10_68 12.965425
## X10_69 13.186276
## X11_1  13.199825
## X11_3  12.195960
## X14_20 19.698534
## X14_21 14.910568
## X14_22 14.070685
## X14_23 23.233005
## X14_25 19.924708
## X14_27 26.083193
## X14_29 18.125905
## X14_30 21.059405
## X14_33 17.598106
## X14_34 12.695835
## X14_35 18.362334
## X14_36 15.547467
```

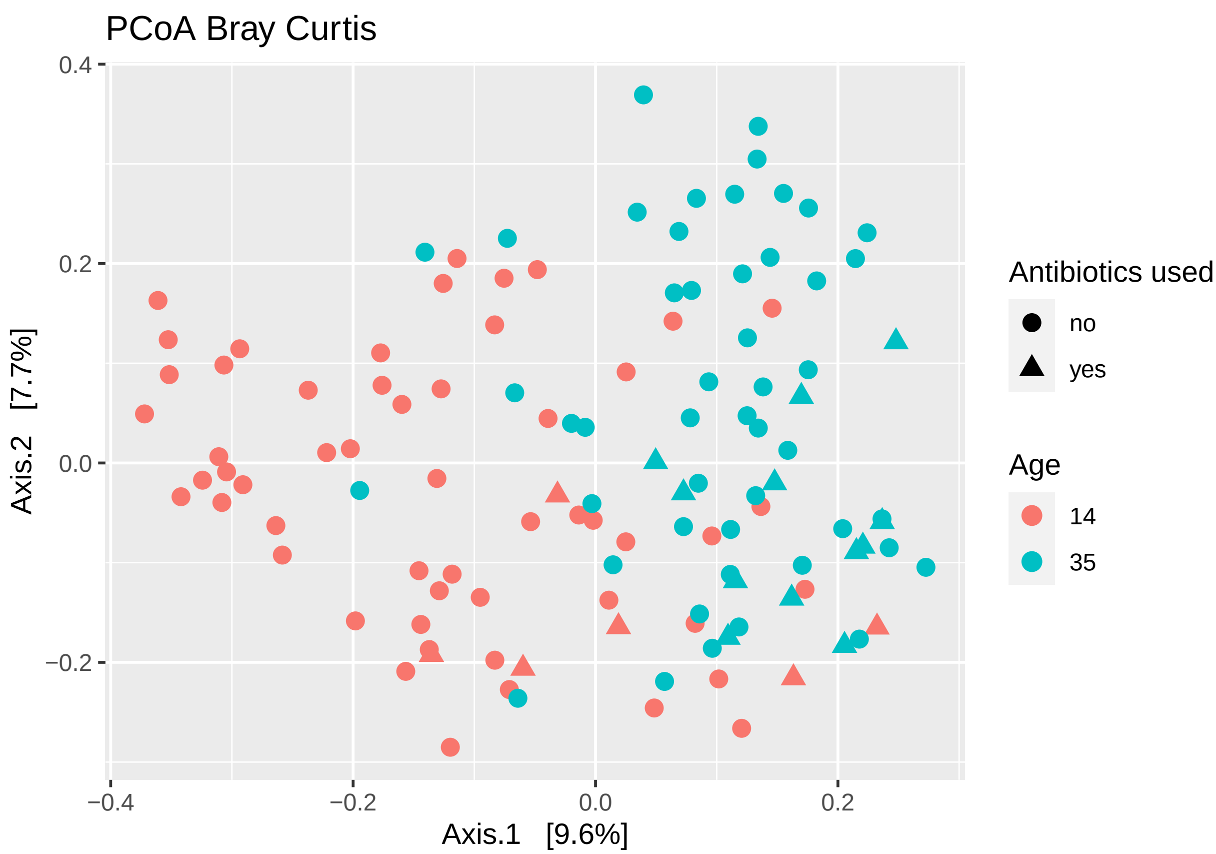
```
dist = "bray"
ord_meths = c("DCA", "CCA", "RDA", "NMDS", "MDS", "PCoA", "DPCoA")
plist = llply(as.list(ord_meths), function(i, physeq, dist){
  ordi = ordinate(subset16S, method=i, distance=dist)
  plot_ordination(subset16S, ordi, "samples", color="Age", shape = "AB")
}, subset16S, dist)
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2084961
## Run 1 stress 0.2317321
## Run 2 stress 0.2126819
## Run 3 stress 0.2337359
## Run 4 stress 0.2085024
## ... Procrustes: rmse 0.0007735775  max resid 0.00620484
## ... Similar to previous best
## Run 5 stress 0.211993
## Run 6 stress 0.2095192
## Run 7 stress 0.2208887
## Run 8 stress 0.2247976
## Run 9 stress 0.2159559
## Run 10 stress 0.2188857
## Run 11 stress 0.2295143
## Run 12 stress 0.2095333
## Run 13 stress 0.4136506
## Run 14 stress 0.2308722
## Run 15 stress 0.226104
## Run 16 stress 0.2219128
## Run 17 stress 0.2119357
## Run 18 stress 0.2252078
## Run 19 stress 0.2127853
## Run 20 stress 0.2095192
## *** Best solution repeated 1 times
```

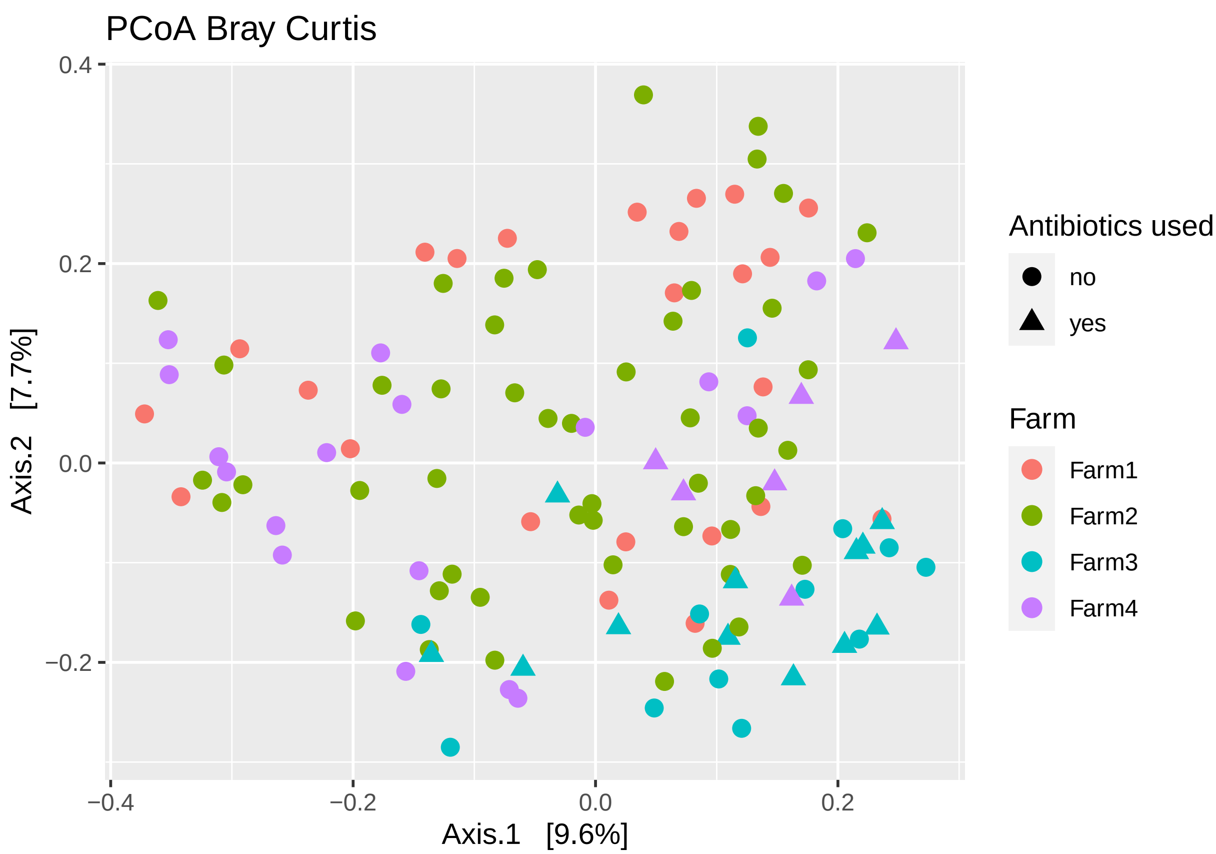
```
names(plist) <- ord_meths

pdataframe = ldply(plist, function(x){
  df = x$data[, 1:2]
  colnames(df) = c("Axis_1", "Axis_2")
  return(cbind(df, x$data))
})
names(pdataframe)[1] = "method"
ggplot(pdataframe, aes(Axis_1, Axis_2, color=Age, shape=AB)) +
  geom_point(size=4) +
  facet_wrap(~method, scales="free") +
  scale_fill_brewer(type="qual", palette="Set1") +
  scale_colour_brewer(type="qual", palette="Set1") +
  ggtitle("Different ordination methods for 16S data (Bray-Curtis)")
```



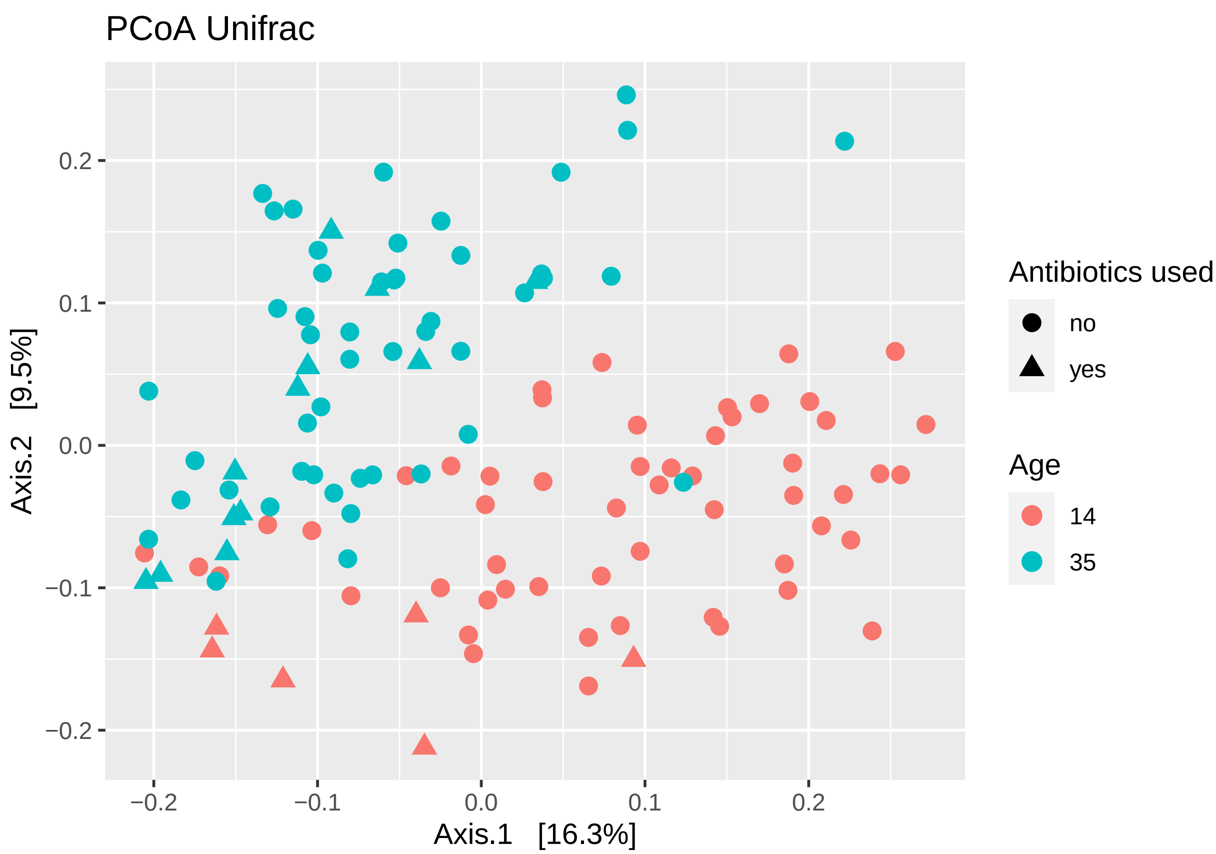

```r
# PCoAs for different methods

# functionize plotting pcoa
plot_pcoa_ordination <- function(data, pcoa, var, title) {
  p <- plot_ordination(data, pcoa, color = var, shape = "AB") +
    geom_point(size = 3) +
    labs(title = title, color = var, shape = "Antibiotics used")

  return(p)
}

pcoa_bc = ordinate(subset16S, "PCoA", "bray")
pcoa_unifrac = ordinate(subset16S, "PCoA", "unifrac")
pcoa_wunifrac = ordinate(subset16S, "PCoA", "wunifrac")
pcoa_jsd = ordinate(subset16S, "PCoA", "jsd")
pcoa_jaccard = ordinate(subset16S, "PCoA", "jaccard", binary=TRUE)


plot_pcoa_ordination(subset16S, pcoa_bc, "Age", "PCoA Bray Curtis")
```



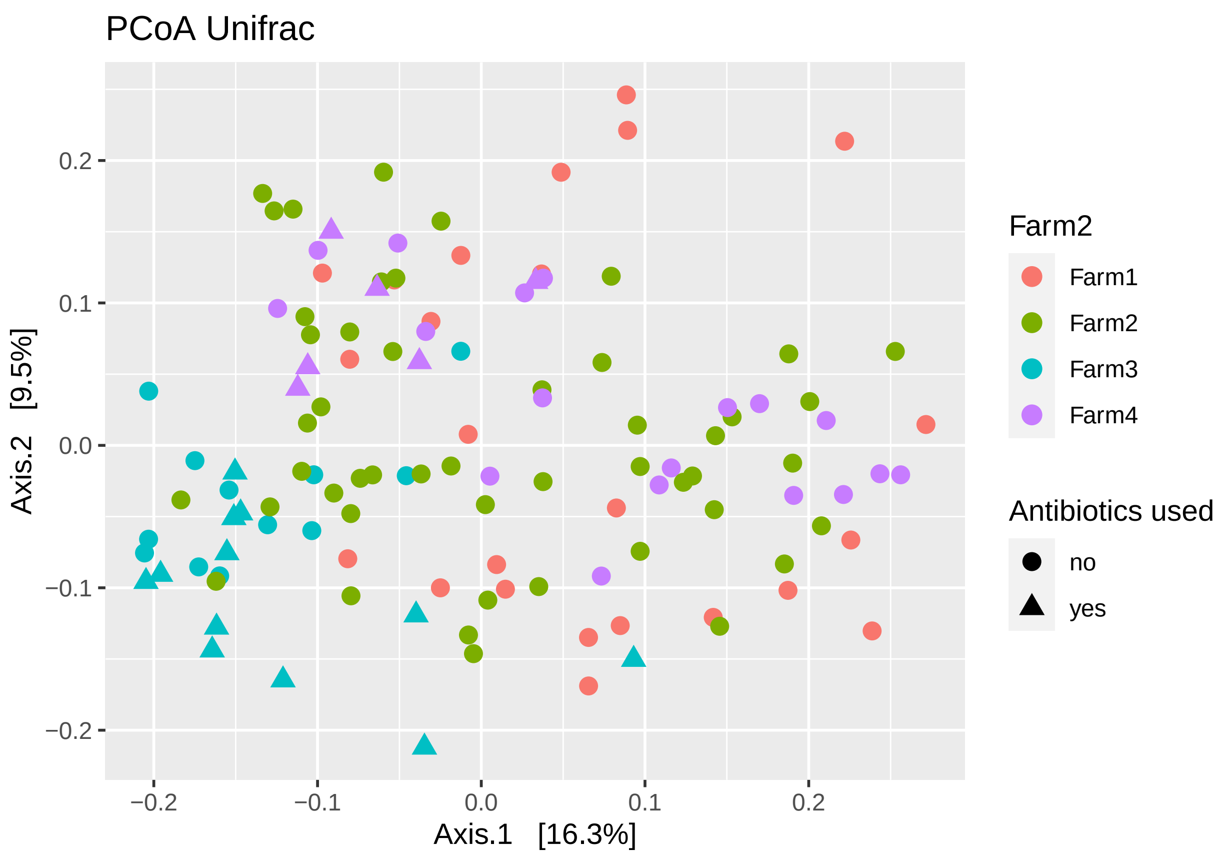

```r
# proper order of legend:
plot_ordination(subset16S, pcoa_bc, color = "Farm2", shape = "AB") +
  geom_point(size = 3) +
  labs(title = "PCoA Bray Curtis", color = "Farm", shape = "Antibiotics used")
```



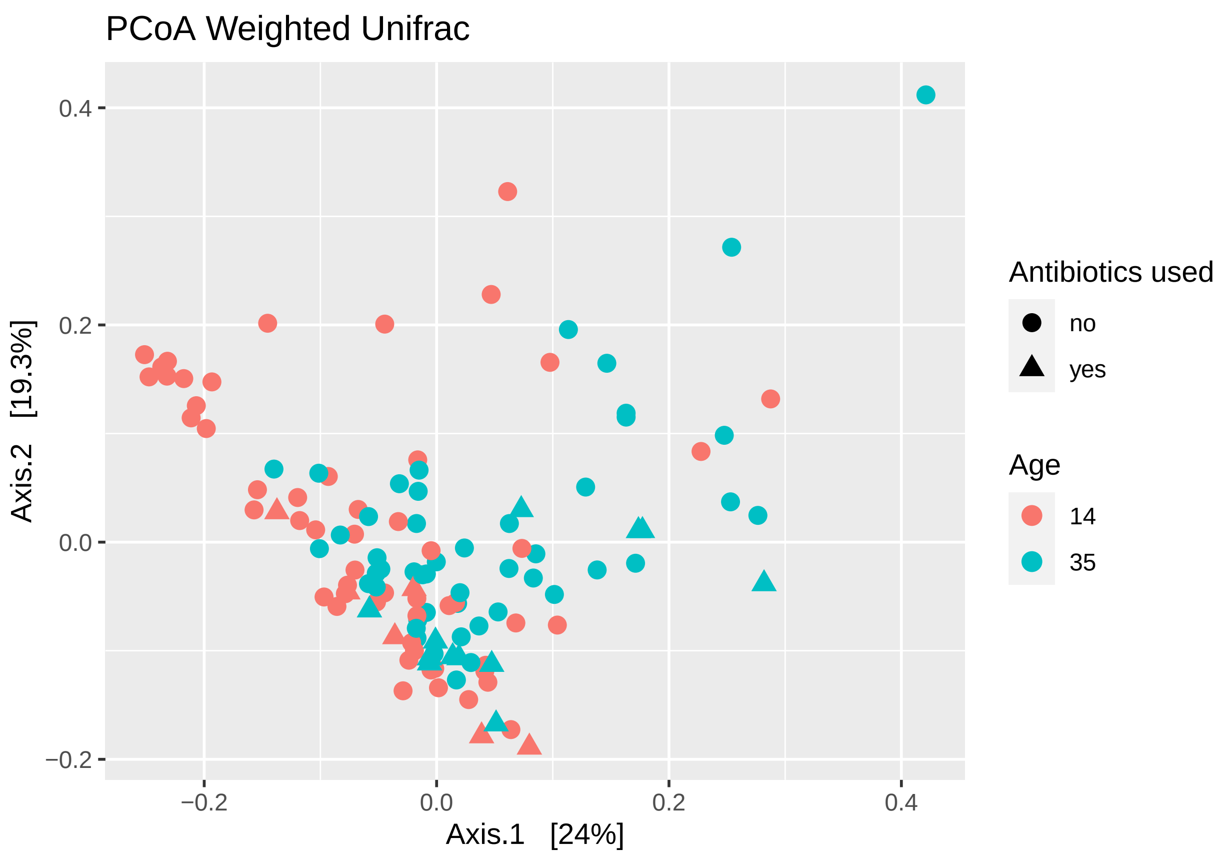

```
plot_pcoa_ordination(subset16S, pcoa_unifrac, "Age", "PCoA Unifrac")
```



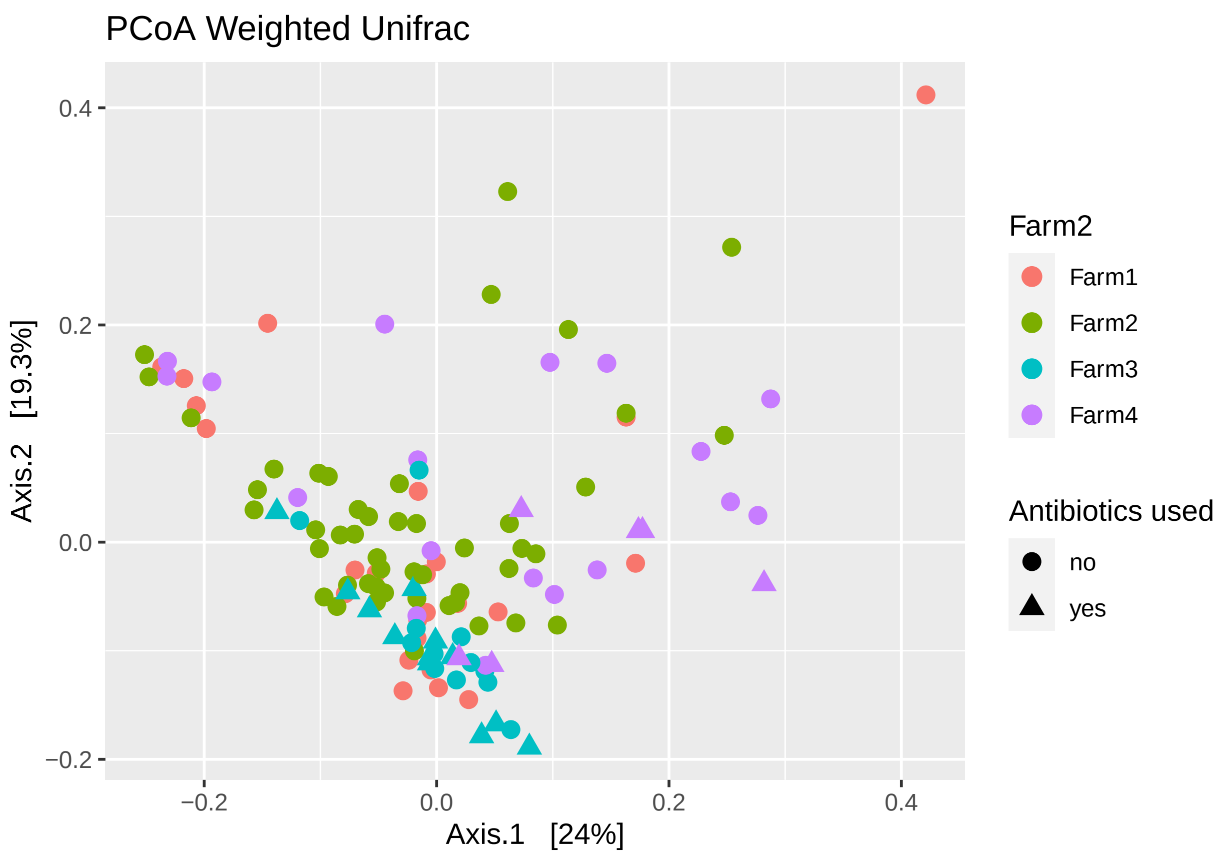

```
plot_pcoa_ordination(subset16S, pcoa_unifrac, "Farm2", "PCoA Unifrac")
```



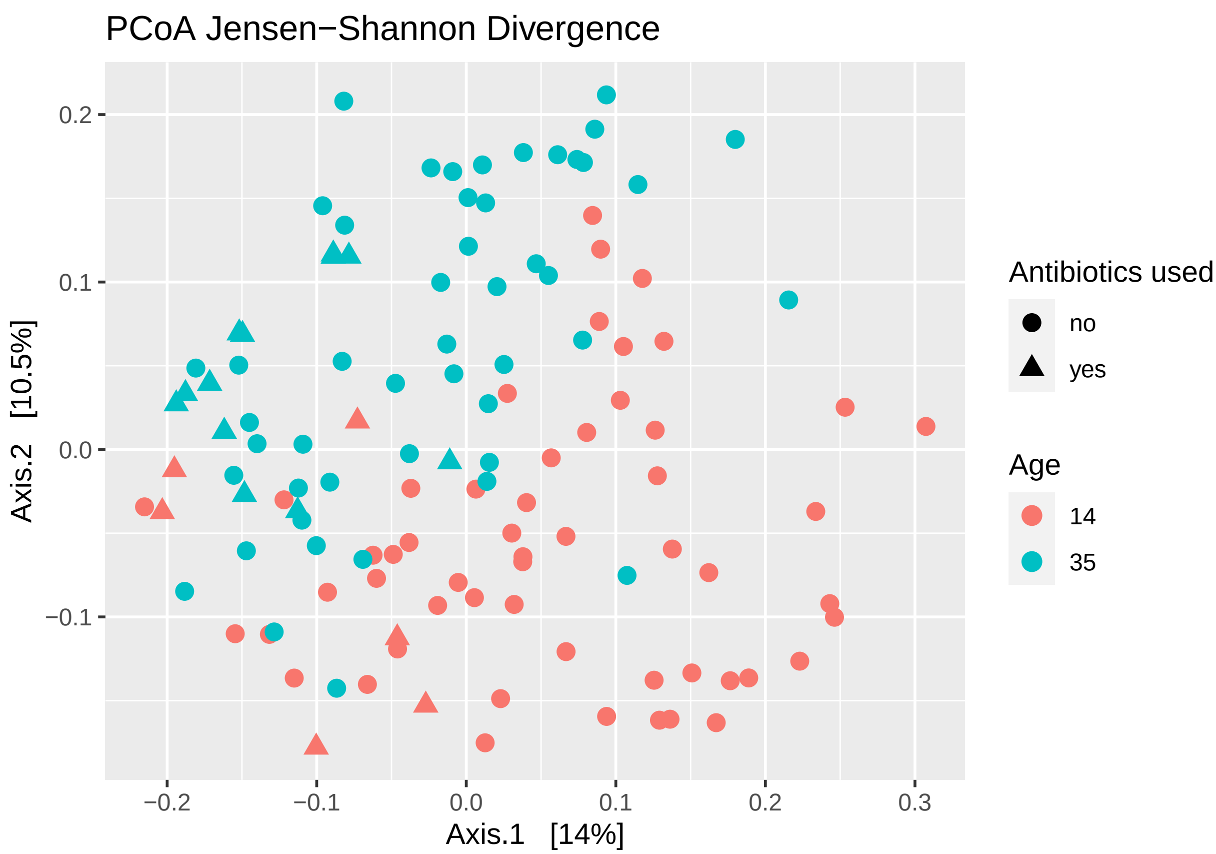

```
plot_pcoa_ordination(subset16S, pcoa_wunifrac, "Age", "PCoA Weighted Unifrac")
```



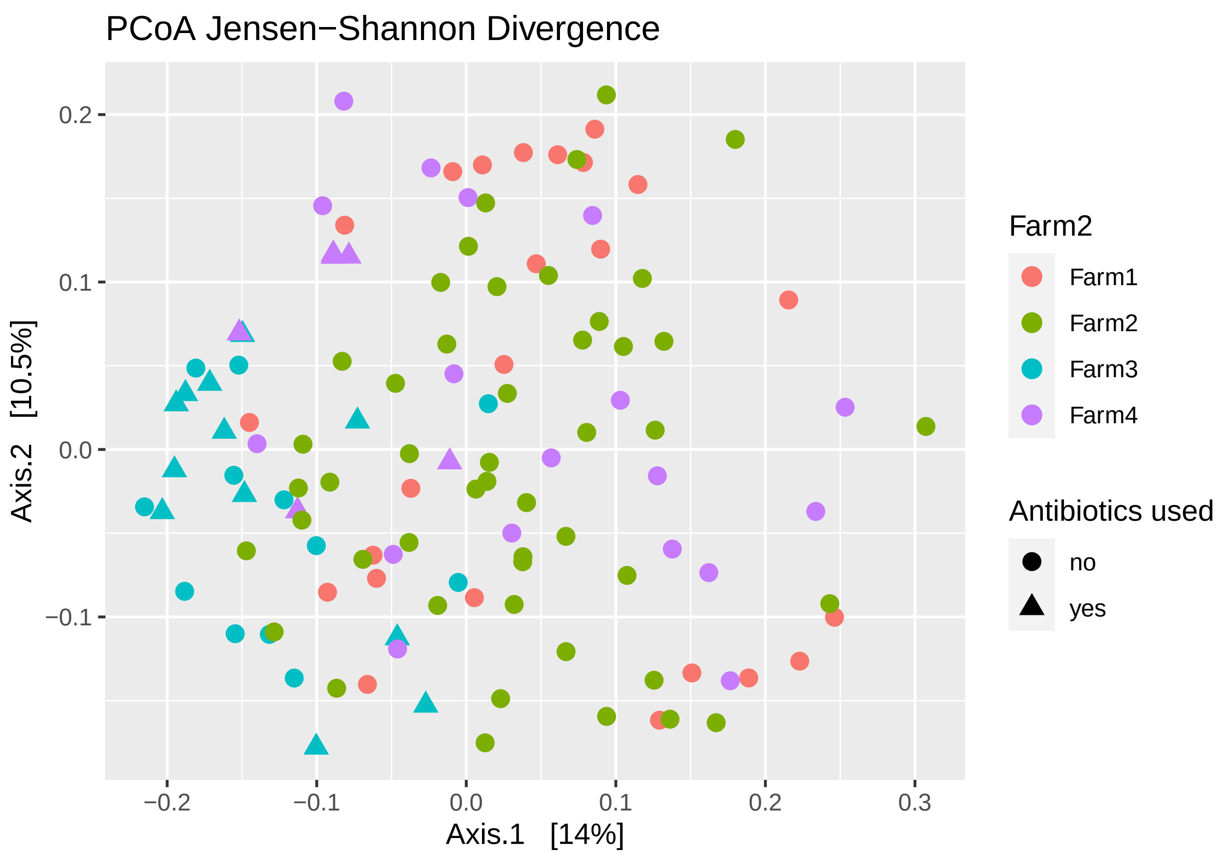

```
plot_pcoa_ordination(subset16S, pcoa_wunifrac, "Farm2", "PCoA Weighted Unifrac")
```



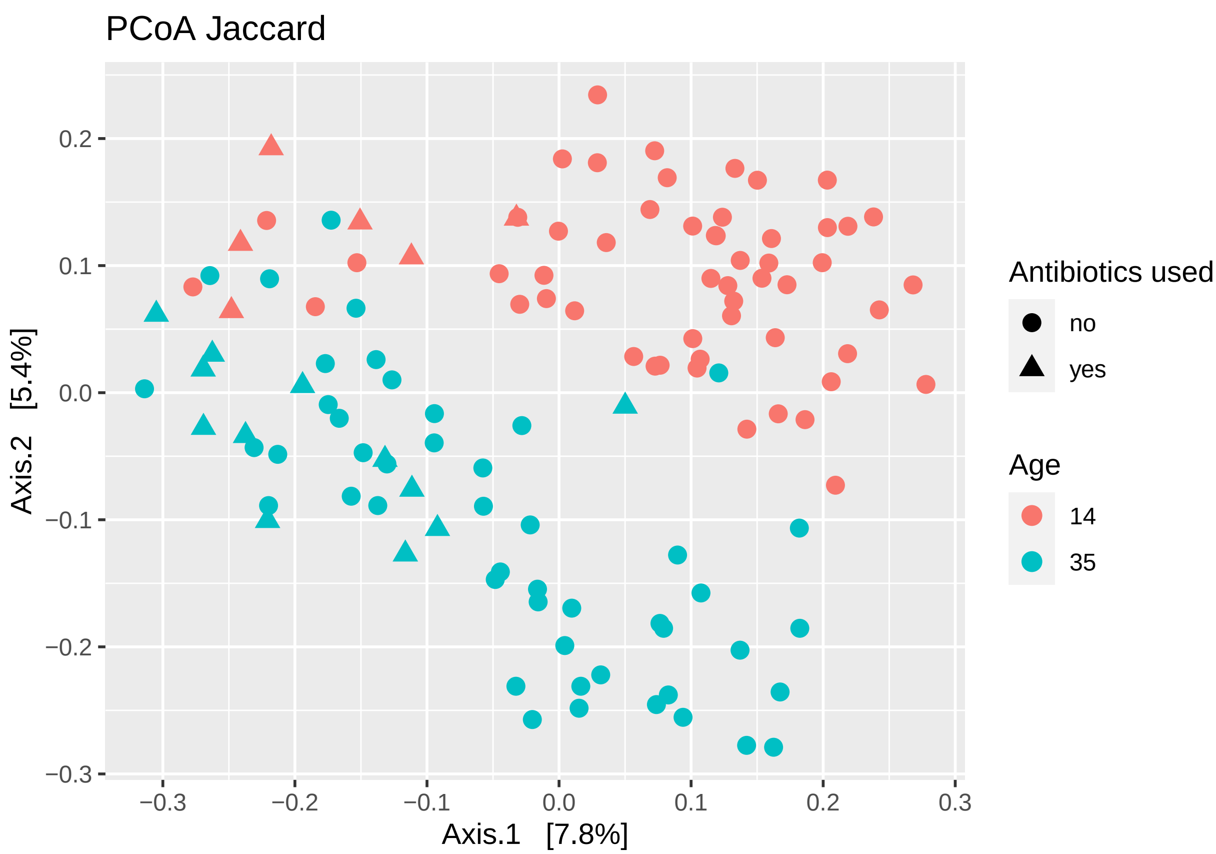

```
plot_pcoa_ordination(subset16S, pcoa_jsd, "Age", "PCoA Jensen-Shannon Divergence")
```



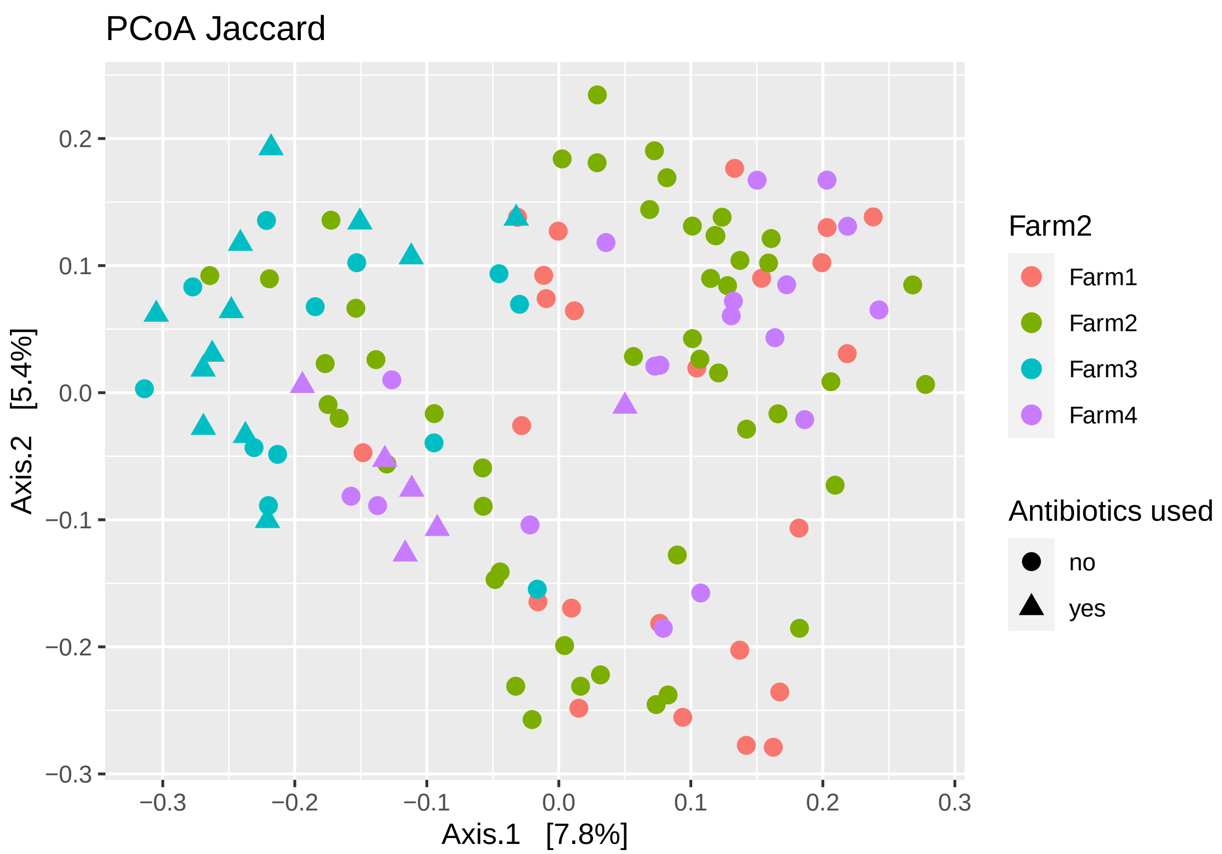

```
plot_pcoa_ordination(subset16S, pcoa_jsd, "Farm2", "PCoA Jensen-Shannon Divergence")
```



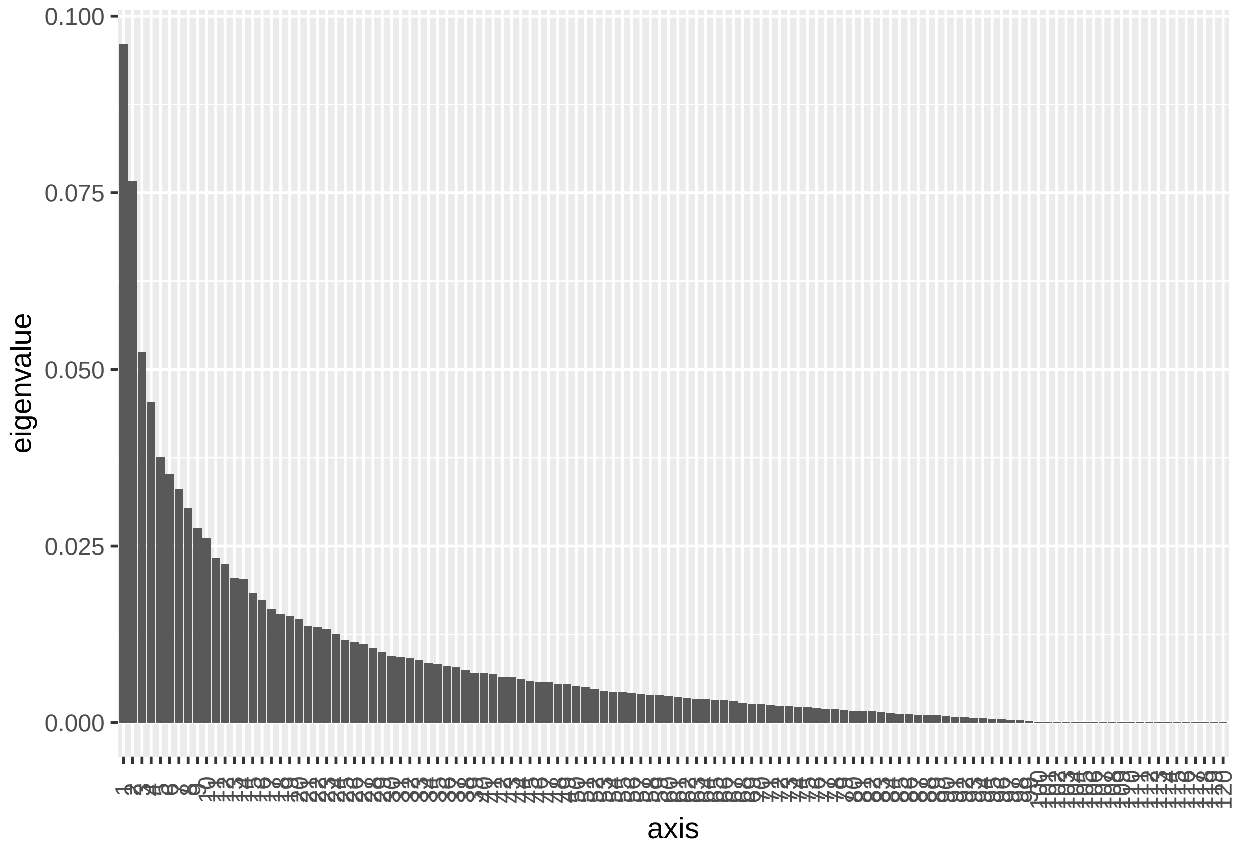

```
plot_pcoa_ordination(subset16S, pcoa_jaccard, "Age", "PCoA Jaccard")
```



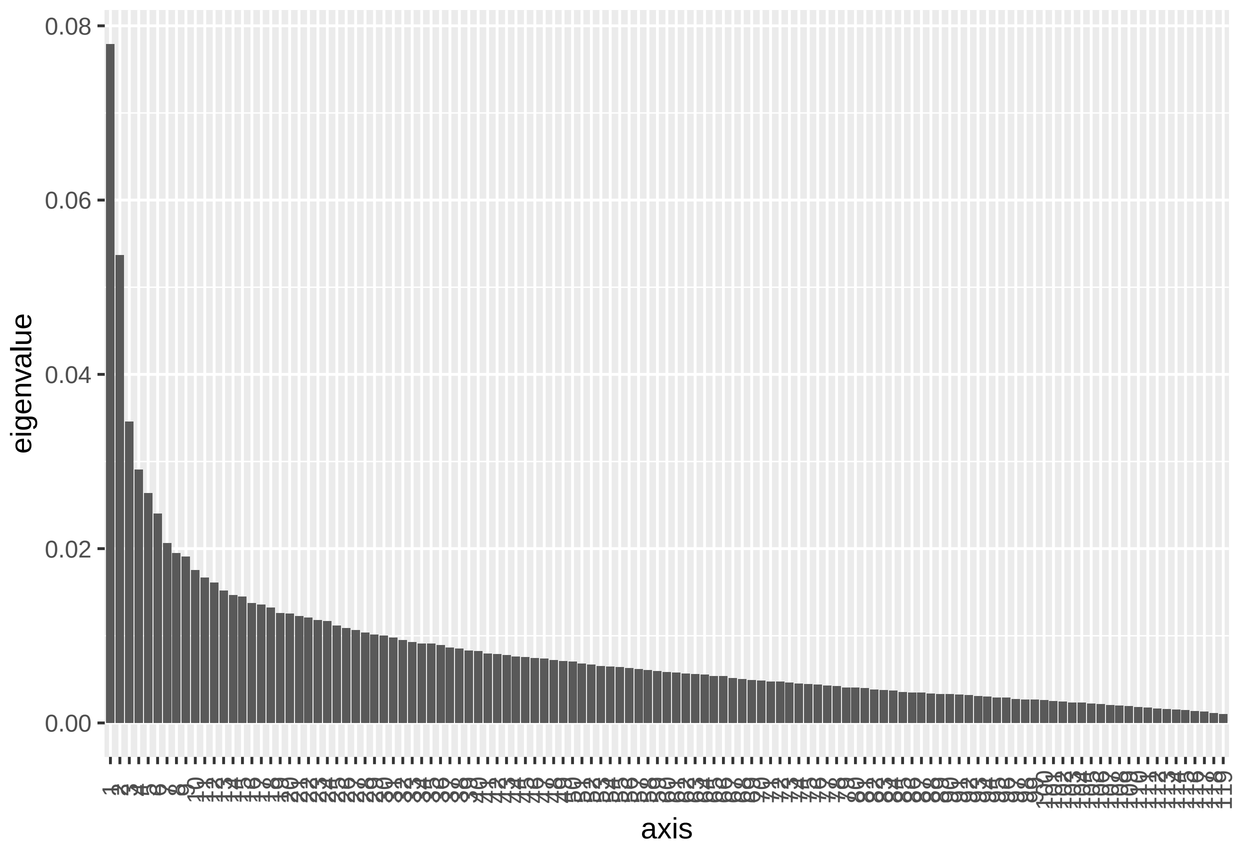

```
plot_pcoa_ordination(subset16S, pcoa_jaccard, "Farm2", "PCoA Jaccard")
```



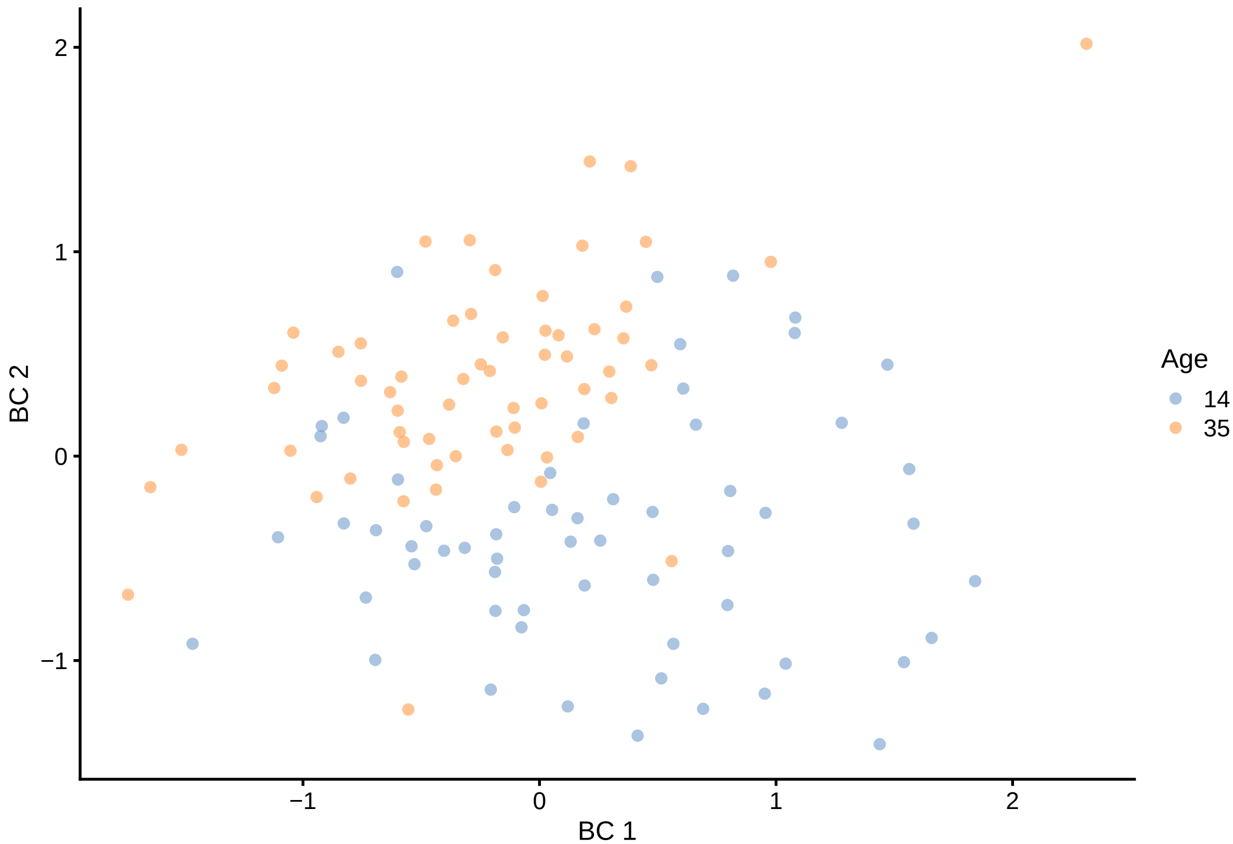

```
#scree plots can be made for any of the PCoAs, those that explain less than 10% of variance on first a
plot_scree(pcoa_bc)
```




```
plot_scree(pcoa_jaccard)
```




```r
# NMDS

tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)
tse %<>%  transformCounts( method = "relabundance")
tse %<>% runNMDS(FUN = vegan::vegdist, name = "BC", nmdsFUN = "monoMDS",
                 exprs_values = "relabundance",
                 keep_dist = TRUE)

tse %>% plotReducedDim("BC", colour_by = "Age")
```



PERMANOVAs

```
tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)
tse <- transformCounts(tse, method = "relabundance")

adonis2(t(assay(tse, "relabundance")) ~ AB, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ AB, data = colData(tse), permutations = 9999)
##           Df SumOfSqs      R2     F Pr(>F)
## AB         1    0.867 0.02591 3.139  1e-04 ***
## Residual 118   32.594 0.97409
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(t(assay(tse, "relabundance")) ~ Cox, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
```

```
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ Cox, data = colData(tse), permutations = 9999)
##           Df SumOfSqs      R2      F Pr(>F)
## Cox        3    3.424 0.10233 4.4078  1e-04 ***
## Residual 116   30.037 0.89767
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse, "relabundance")) ~ Researcher, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ Researcher, data = colData(tse), permutations = 99
##             Df SumOfSqs      R2      F Pr(>F)
## Researcher   4    1.942 0.05803 1.7711  1e-04 ***
## Residual   115   31.520 0.94197
## Total      119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse, "relabundance")) ~ FeedProducent, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ FeedProducent, data = colData(tse), permutations =
##                Df SumOfSqs     R2     F Pr(>F)
## FeedProducent   2    2.262 0.0676 4.241  1e-04 ***
## Residual      117   31.200 0.9324
## Total         119   33.462 1.0000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse, "relabundance")) ~ LitterType, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ LitterType, data = colData(tse), permutations = 99
##             Df SumOfSqs      R2     F Pr(>F)
## LitterType   2    2.054 0.06137 3.825  1e-04 ***
## Residual   117   31.408 0.93863
## Total      119   33.462 1.00000
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse, "relabundance")) ~ FeedType, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ FeedType, data = colData(tse), permutations = 9999)
##           Df SumOfSqs      R2      F Pr(>F)
## FeedType   1    1.828 0.05464 6.8206  1e-04 ***
## Residual 118   31.633 0.94536
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse, "relabundance")) ~ Gender, data = colData(tse), permutations = 9999) # NOT signifi
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ Gender, data = colData(tse), permutations = 9999)
##           Df SumOfSqs      R2      F Pr(>F)
## Gender     1    0.247 0.00739 0.8784 0.6816
## Residual 118   33.214 0.99261
## Total    119   33.462 1.00000
```

```r
adonis2(t(assay(tse, "relabundance")) ~ Stables, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ Stables, data = colData(tse), permutations = 9999)
##           Df SumOfSqs      R2      F Pr(>F)
## Stables    9    5.606 0.16753 2.4596  1e-04 ***
## Residual 110   27.856 0.83247
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse, "relabundance")) ~ FlockSize, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
```

```
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ FlockSize, data = colData(tse), permutations = 9999
##            Df SumOfSqs      R2      F Pr(>F)
## FlockSize   5    4.167 0.12453 3.2432  1e-04 ***
## Residual  114   29.295 0.87547
## Total     119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse, "relabundance")) ~ Farm2, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ Farm2, data = colData(tse), permutations = 9999)
##           Df SumOfSqs      R2      F Pr(>F)
## Farm2      3    3.452 0.10315 4.4474  1e-04 ***
## Residual 116   30.010 0.89685
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse, "relabundance")) ~ AgeParentStock, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ AgeParentStock, data = colData(tse), permutations =
##                 Df SumOfSqs      R2      F Pr(>F)
## AgeParentStock   4    3.980 0.11895 3.8817  1e-04 ***
## Residual       115   29.481 0.88105
## Total          119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse, "relabundance")) ~ Age, data = colData(tse), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse, "relabundance")) ~ Age, data = colData(tse), permutations = 9999)
##           Df SumOfSqs      R2      F Pr(>F)
## Age        1    1.828 0.05464 6.8206  1e-04 ***
## Residual 118   31.633 0.94536
## Total    119   33.462 1.00000
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
# variances: AB: 0.026, Cox: 0.102, Researcher: 0.06, FP : 0.067, LitterType: 0.061, FT :0.055, Gender:
# Stable: 0.167, FS: 0.1245, Farm 0.103, APS : 0.118, Age: 0.054
# Order: Stable>FS>APS>Farm>Cox>FP>LT>Researcher>FT>Age>AB>Gender

# Mixed models ( out of scope)
#adonis2(t(assay(tse, "relabundance")) ~ Stables * AB, data = colData(tse), permutations = 9999)


# basically, composition seems to be different over every single variable, except for gender

# on genus level
tse_genus <- agglomerateByRank(tse, "Genus")
tse_genus <- transformCounts(tse_genus, method = "relabundance")

adonis2(t(assay(tse_genus, "relabundance")) ~ AB, data = colData(tse_genus), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ AB, data = colData(tse_genus), permutations =
##           Df SumOfSqs      R2      F Pr(>F)
## AB         1   0.4471 0.03209 3.9117  4e-04 ***
## Residual 118  13.4862 0.96791
## Total    119  13.9333 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse_genus, "relabundance")) ~ Cox, data = colData(tse_genus), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ Cox, data = colData(tse_genus), permutations
##           Df SumOfSqs      R2      F Pr(>F)
## Cox        3    1.505 0.10801 4.6823  1e-04 ***
## Residual 116   12.428 0.89199
## Total    119   13.933 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse_genus, "relabundance")) ~ Researcher, data = colData(tse_genus), permutations = 9999
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
```

```
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ Researcher, data = colData(tse_genus), permu
##             Df SumOfSqs      R2      F Pr(>F)
## Researcher   4   1.0471 0.07515 2.3362  2e-04 ***
## Residual   115  12.8862 0.92485
## Total      119  13.9333 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(t(assay(tse_genus, "relabundance")) ~ FeedProducent, data = colData(tse_genus), permutations = 9
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ FeedProducent, data = colData(tse_genus), pe
##                Df SumOfSqs      R2      F Pr(>F)
## FeedProducent   2   0.9176 0.06586 4.1241  1e-04 ***
## Residual      117  13.0157 0.93414
## Total         119  13.9333 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(t(assay(tse_genus, "relabundance")) ~ LitterType, data = colData(tse_genus), permutations = 9999
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ LitterType, data = colData(tse_genus), permu
##             Df SumOfSqs      R2      F Pr(>F)
## LitterType   2   0.6996 0.05021 3.0926  1e-04 ***
## Residual   117  13.2337 0.94979
## Total      119  13.9333 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(t(assay(tse_genus, "relabundance")) ~ FeedType, data = colData(tse_genus), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ FeedType, data = colData(tse_genus), permuta
##           Df SumOfSqs      R2      F Pr(>F)
## FeedType   1   0.9844 0.07065 8.9705  1e-04 ***
## Residual 118  12.9489 0.92935
## Total    119  13.9333 1.00000
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse_genus, "relabundance")) ~ Gender, data = colData(tse_genus), permutations = 9999) #
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ Gender, data = colData(tse_genus), permutati
##           Df SumOfSqs      R2      F Pr(>F)
## Gender     1   0.1175 0.00843 1.0033 0.4282
## Residual 118  13.8158 0.99157
## Total    119  13.9333 1.00000
```

```r
adonis2(t(assay(tse_genus, "relabundance")) ~ Stables, data = colData(tse_genus), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ Stables, data = colData(tse_genus), permutat
##           Df SumOfSqs      R2      F Pr(>F)
## Stables    9   2.3359 0.16765 2.4618  1e-04 ***
## Residual 110  11.5974 0.83235
## Total    119  13.9333 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse_genus, "relabundance")) ~ FlockSize, data = colData(tse_genus), permutations = 9999
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ FlockSize, data = colData(tse_genus), permuta
##            Df SumOfSqs      R2      F Pr(>F)
## FlockSize   5   1.7048 0.12235 3.1785  1e-04 ***
## Residual  114  12.2285 0.87765
## Total     119  13.9333 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(t(assay(tse_genus, "relabundance")) ~ Farm2, data = colData(tse_genus), permutations = 9999)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
```

```
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ Farm2, data = colData(tse_genus), permutatio
##           Df SumOfSqs      R2      F Pr(>F)
## Farm2      3   1.3884 0.09965 4.2795  1e-04 ***
## Residual 116  12.5449 0.90035
## Total    119  13.9333 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(t(assay(tse_genus, "relabundance")) ~ AgeParentStock, data = colData(tse_genus), permutations =
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 9999
##
## adonis2(formula = t(assay(tse_genus, "relabundance")) ~ AgeParentStock, data = colData(tse_genus), pe
##                 Df SumOfSqs      R2      F Pr(>F)
## AgeParentStock   4   1.5725 0.11286 3.6576  1e-04 ***
## Residual       115  12.3608 0.88714
## Total          119  13.9333 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# same trends on genus level (and on phylum level, though p values become higher)
```

for different ordination methods

```
ps1.rel <- microbiome::transform(subset16S, "compositional")
metadf <- data.frame(sample_data(ps1.rel))

# alternative calculations
#otu <- abundances(ps1.rel)
#meta <- meta(ps1.rel)
#adonis2(t(otu) ~ Age, data = meta, permutations=9999, method = "bray")

#permanova = adonis(t(otu) ~ Age, data = meta, permutations=9999, method = "bray")
#permanova$aov.tab

unifrac.dist <- UniFrac(ps1.rel)

adonis2(unifrac.dist ~ Age, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = unifrac.dist ~ Age, data = metadf)
```

```
##           Df SumOfSqs      R2      F Pr(>F)
## Age        1   1.0901 0.09194 11.947  0.001 ***
## Residual 118  10.7664 0.90806
## Total    119  11.8565 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(unifrac.dist ~ AB, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = unifrac.dist ~ AB, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## AB         1   0.4532 0.03822 4.6893  0.001 ***
## Residual 118  11.4033 0.96178
## Total    119  11.8565 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(unifrac.dist ~ Farm2, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = unifrac.dist ~ Farm2, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Farm2      3   1.5651 0.13201 5.8806  0.001 ***
## Residual 116  10.2914 0.86799
## Total    119  11.8565 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(unifrac.dist ~ Cox, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = unifrac.dist ~ Cox, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Cox        3   1.8178 0.15331 7.0015  0.001 ***
## Residual 116  10.0388 0.84669
## Total    119  11.8565 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(unifrac.dist ~ Researcher, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = unifrac.dist ~ Researcher, data = metadf)
##             Df SumOfSqs      R2     F Pr(>F)
## Researcher   4   0.8538 0.07201 2.231  0.001 ***
## Residual   115  11.0027 0.92799
## Total      119  11.8565 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(unifrac.dist ~ LitterType, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = unifrac.dist ~ LitterType, data = metadf)
##             Df SumOfSqs      R2      F Pr(>F)
## LitterType   2   0.7815 0.06591 4.1281  0.001 ***
## Residual   117  11.0750 0.93409
## Total      119  11.8565 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(unifrac.dist ~ Gender, data = metadf) # not sign
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = unifrac.dist ~ Gender, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Gender     1   0.0947 0.00799 0.9502  0.518
## Residual 118  11.7618 0.99201
## Total    119  11.8565 1.00000
```

```r
adonis2(unifrac.dist ~ Stables, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = unifrac.dist ~ Stables, data = metadf)
```

```
##           Df SumOfSqs      R2      F Pr(>F)
## Stables    9   2.5652 0.21636 3.3744  0.001 ***
## Residual 110   9.2913 0.78364
## Total    119  11.8565 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# same patterns arise

wunifrac.dist <- UniFrac(ps1.rel,
                         weighted = TRUE)

adonis2(wunifrac.dist ~ Age, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = wunifrac.dist ~ Age, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Age        1   0.4772 0.06566 8.2918  0.001 ***
## Residual 118   6.7911 0.93434
## Total    119   7.2683 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(wunifrac.dist ~ AB, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = wunifrac.dist ~ AB, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## AB         1   0.2231 0.03069 3.7362  0.002 **
## Residual 118   7.0452 0.96931
## Total    119   7.2683 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(wunifrac.dist ~ Farm2, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = wunifrac.dist ~ Farm2, data = metadf)
##           Df SumOfSqs      R2     F Pr(>F)
## Farm2      3   0.7339 0.10098 4.343  0.001 ***
```

```
## Residual 116   6.5344 0.89902
## Total    119   7.2683 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(wunifrac.dist ~ Cox, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = wunifrac.dist ~ Cox, data = metadf)
##           Df SumOfSqs     R2      F Pr(>F)
## Cox        3   0.7493 0.1031 4.4446  0.001 ***
## Residual 116   6.5190 0.8969
## Total    119   7.2683 1.0000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(wunifrac.dist ~ Researcher, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = wunifrac.dist ~ Researcher, data = metadf)
##             Df SumOfSqs      R2      F Pr(>F)
## Researcher   4   0.5650 0.07773 2.4232  0.001 ***
## Residual   115   6.7033 0.92227
## Total      119   7.2683 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(wunifrac.dist ~ LitterType, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = wunifrac.dist ~ LitterType, data = metadf)
##             Df SumOfSqs      R2      F Pr(>F)
## LitterType   2   0.3604 0.04959 3.0524  0.001 ***
## Residual   117   6.9079 0.95041
## Total      119   7.2683 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(wunifrac.dist ~ Gender, data = metadf) # not sign
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = wunifrac.dist ~ Gender, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Gender     1   0.0359 0.00493 0.5849   0.84
## Residual 118   7.2325 0.99507
## Total    119   7.2683 1.00000
```

```
adonis2(wunifrac.dist ~ Stables, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = wunifrac.dist ~ Stables, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Stables    9   1.2663 0.17422 2.5785  0.001 ***
## Residual 110   6.0021 0.82578
## Total    119   7.2683 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#  same patterns

jsd.dist <- phyloseq::distance(ps1.rel, "jsd")

adonis2(jsd.dist ~ Age, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jsd.dist ~ Age, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Age        1   0.8836 0.07447 9.4942  0.001 ***
## Residual 118  10.9818 0.92553
## Total    119  11.8654 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jsd.dist ~ AB, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
```

```
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jsd.dist ~ AB, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## AB         1   0.4364 0.03678 4.5059  0.001 ***
## Residual 118  11.4290 0.96322
## Total    119  11.8654 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jsd.dist ~ Farm2, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jsd.dist ~ Farm2, data = metadf)
##           Df SumOfSqs     R2      F Pr(>F)
## Farm2      3   1.6671 0.1405 6.3206  0.001 ***
## Residual 116  10.1983 0.8595
## Total    119  11.8654 1.0000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jsd.dist ~ Cox, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jsd.dist ~ Cox, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Cox        3   1.6355 0.13783 6.1817  0.001 ***
## Residual 116  10.2299 0.86217
## Total    119  11.8654 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jsd.dist ~ Researcher, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jsd.dist ~ Researcher, data = metadf)
##             Df SumOfSqs      R2      F Pr(>F)
## Researcher   4   0.8256 0.06958 2.1499  0.001 ***
## Residual   115  11.0398 0.93042
```

```
## Total      119  11.8654 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(jsd.dist ~ LitterType, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jsd.dist ~ LitterType, data = metadf)
##             Df SumOfSqs      R2     F Pr(>F)
## LitterType   2    0.970 0.08175 5.208  0.001 ***
## Residual   117   10.895 0.91825
## Total      119   11.865 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
adonis2(jsd.dist ~ Gender, data = metadf) # not sign
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jsd.dist ~ Gender, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Gender     1   0.0978 0.00824 0.9809  0.478
## Residual 118  11.7676 0.99176
## Total    119  11.8654 1.00000
```

```r
adonis2(jsd.dist ~ Stables, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jsd.dist ~ Stables, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Stables    9   2.5398 0.21405 3.3287  0.001 ***
## Residual 110   9.3256 0.78595
## Total    119  11.8654 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
# same is true for JSD

bray.dist <- phyloseq::distance(ps1.rel, "bray")

adonis2(bray.dist ~ Age, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = bray.dist ~ Age, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Age        1    1.828 0.05464 6.8206  0.001 ***
## Residual 118   31.633 0.94536
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(bray.dist ~ AB, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = bray.dist ~ AB, data = metadf)
##           Df SumOfSqs      R2     F Pr(>F)
## AB         1    0.867 0.02591 3.139  0.001 ***
## Residual 118   32.594 0.97409
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(bray.dist ~ Farm2, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = bray.dist ~ Farm2, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Farm2      3    3.452 0.10315 4.4474  0.001 ***
## Residual 116   30.010 0.89685
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(bray.dist ~ Cox, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = bray.dist ~ Cox, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
```

```
## Cox        3    3.424 0.10233 4.4078  0.001 ***
## Residual 116   30.037 0.89767
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(bray.dist ~ Researcher, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = bray.dist ~ Researcher, data = metadf)
##             Df SumOfSqs      R2      F Pr(>F)
## Researcher   4    1.942 0.05803 1.7711  0.001 ***
## Residual   115   31.520 0.94197
## Total      119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(bray.dist ~ LitterType, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = bray.dist ~ LitterType, data = metadf)
##             Df SumOfSqs      R2     F Pr(>F)
## LitterType   2    2.054 0.06137 3.825  0.001 ***
## Residual   117   31.408 0.93863
## Total      119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(bray.dist ~ Gender, data = metadf) # not sign
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = bray.dist ~ Gender, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Gender     1    0.247 0.00739 0.8784  0.694
## Residual 118   33.214 0.99261
## Total    119   33.462 1.00000
```

```
adonis2(bray.dist ~ Stables, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = bray.dist ~ Stables, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Stables    9    5.606 0.16753 2.4596  0.001 ***
## Residual 110   27.856 0.83247
## Total    119   33.462 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# and BC

jaccard.dist <- phyloseq::distance(ps1.rel, "jaccard")

adonis2(jaccard.dist ~ Age, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jaccard.dist ~ Age, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Age        1    1.594 0.03685 4.5146  0.001 ***
## Residual 118   41.670 0.96315
## Total    119   43.264 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jaccard.dist ~ AB, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jaccard.dist ~ AB, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## AB         1    0.813 0.01879 2.2592  0.001 ***
## Residual 118   42.451 0.98121
## Total    119   43.264 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jaccard.dist ~ Farm2, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
```

```
## Number of permutations: 999
##
## adonis2(formula = jaccard.dist ~ Farm2, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Farm2      3    3.226 0.07456 3.1151  0.001 ***
## Residual 116   40.038 0.92544
## Total    119   43.264 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jaccard.dist ~ Cox, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jaccard.dist ~ Cox, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Cox        3    3.172 0.07331 3.0589  0.001 ***
## Residual 116   40.092 0.92669
## Total    119   43.264 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jaccard.dist ~ Researcher, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jaccard.dist ~ Researcher, data = metadf)
##             Df SumOfSqs      R2      F Pr(>F)
## Researcher   4    2.091 0.04833 1.4601  0.001 ***
## Residual   115   41.173 0.95167
## Total      119   43.264 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jaccard.dist ~ LitterType, data = metadf)
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jaccard.dist ~ LitterType, data = metadf)
##             Df SumOfSqs      R2      F Pr(>F)
## LitterType   2    1.950 0.04508 2.7616  0.001 ***
## Residual   117   41.314 0.95492
## Total      119   43.264 1.00000
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis2(jaccard.dist ~ Gender, data = metadf) # not sign
```

```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jaccard.dist ~ Gender, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Gender     1    0.332 0.00766 0.9111  0.701
## Residual 118   42.932 0.99234
## Total    119   43.264 1.00000
```

```
adonis2(jaccard.dist ~ Stables, data = metadf)
```

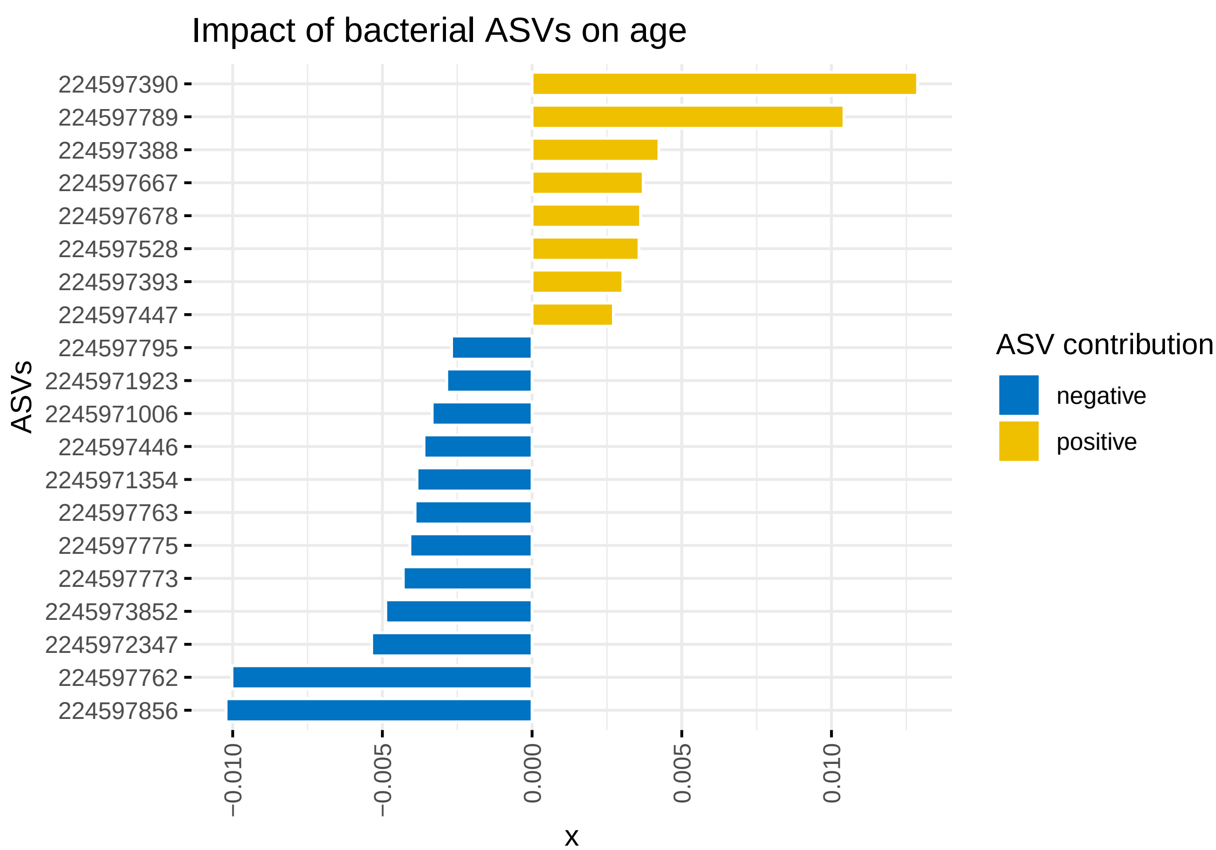
```
## Permutation test for adonis under reduced model
## Terms added sequentially (first to last)
## Permutation: free
## Number of permutations: 999
##
## adonis2(formula = jaccard.dist ~ Stables, data = metadf)
##           Df SumOfSqs      R2      F Pr(>F)
## Stables    9    5.818 0.13447 1.8989  0.001 ***
## Residual 110   37.446 0.86553
## Total    119   43.264 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# as well as jaccard
```

PERMANOVA plots - Age

```
permanova_age <- adonis(t(assay(tse, "relabundance")) ~ Age, data = colData(tse), permutations = 9999)

coef <- coefficients(permanova_age)["Age1",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                       levels = c("negative", "positive"))

ggbarplot(df, x = "y", y = "x",
          fill = "contr",           # change fill color by mpg_level
          color = "white",            # Set bar border colors to white
          palette = "jco",            # jco journal color palett. see ?ggpar
          sort.val = "asc",           # Sort the value in ascending order
```

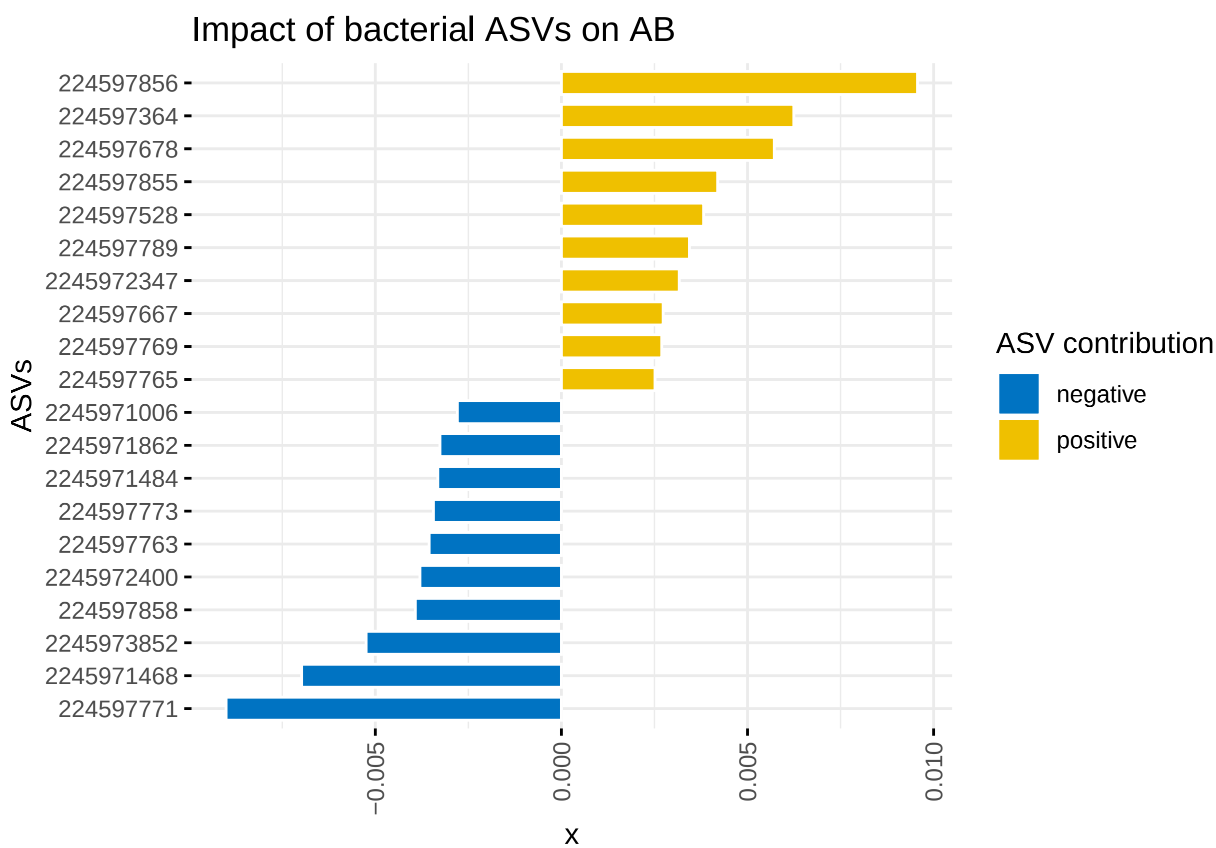
```r
          sort.by.groups = FALSE,      # Don't sort inside each group
          x.text.angle = 90,           # Rotate vertically x axis texts
          xlab = "ASVs",
          legend.title = "ASV contribution",
          title = "Impact of bacterial ASVs on age",
          rotate = TRUE,
          ggtheme = theme_minimal())
```



Antibiotic treament

```r
permanova_AB <- adonis(t(assay(tse, "relabundance")) ~ AB, data = colData(tse), permutations = 9999)

coef <- coefficients(permanova_AB)["AB1",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                           unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                   levels = c("negative", "positive"))

ggbarplot(df, x = "y", y = "x",
          fill = "contr",            # change fill color by mpg_level
          color = "white",             # Set bar border colors to white
          palette = "jco",             # jco journal color palett. see ?ggpar
```

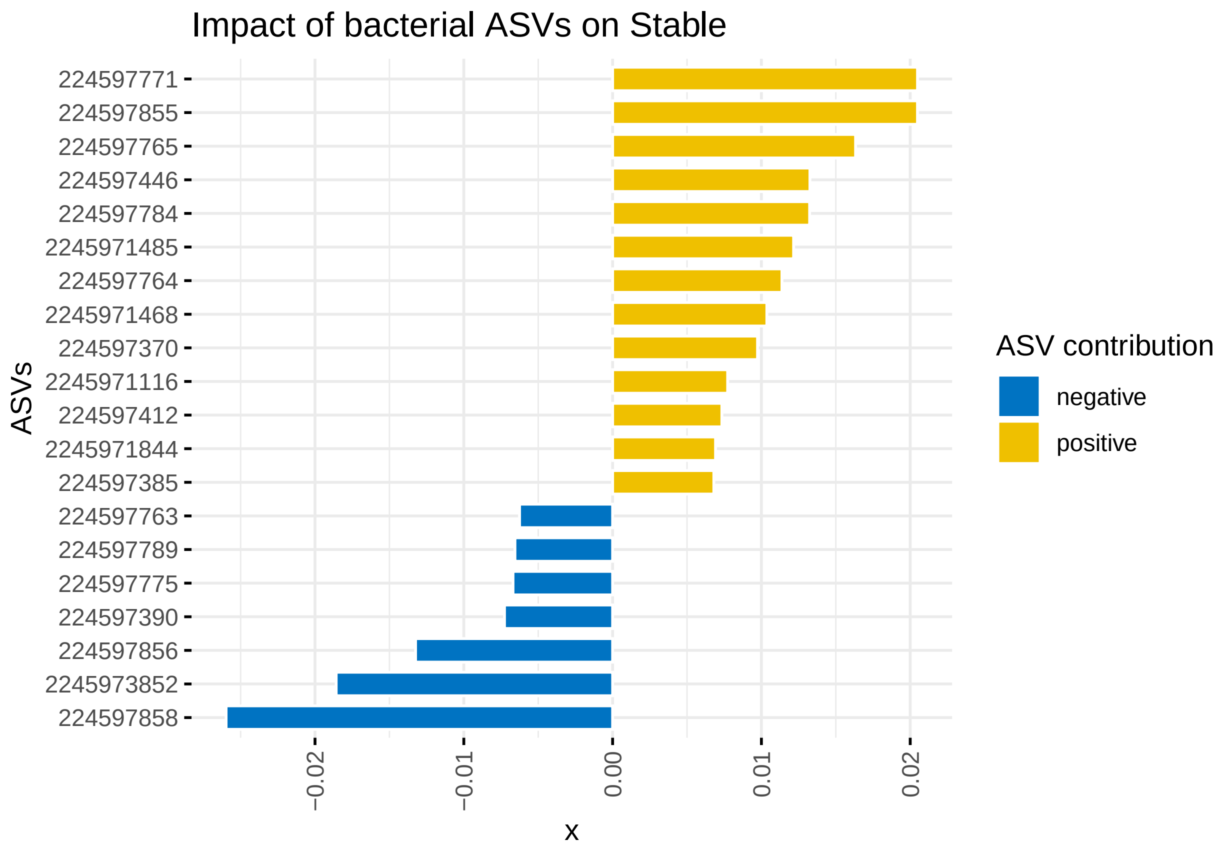
```r
          sort.val = "asc",             # Sort the value in ascending order
          sort.by.groups = FALSE,       # Don't sort inside each group
          x.text.angle = 90,            # Rotate vertically x axis texts
          xlab = "ASVs",
          legend.title = "ASV contribution",
          title = "Impact of bacterial ASVs on AB",
          rotate = TRUE,
          ggtheme = theme_minimal())
```



Stable

```r
permanova_stable <- adonis(t(assay(tse, "relabundance")) ~ Stables, data = colData(tse), permutations =

coef <- coefficients(permanova_stable)["Stables1",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                           unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                   levels = c("negative", "positive"))

ggbarplot(df, x = "y", y = "x",
          fill = "contr",             # change fill color by mpg_level
          color = "white",              # Set bar border colors to white
```

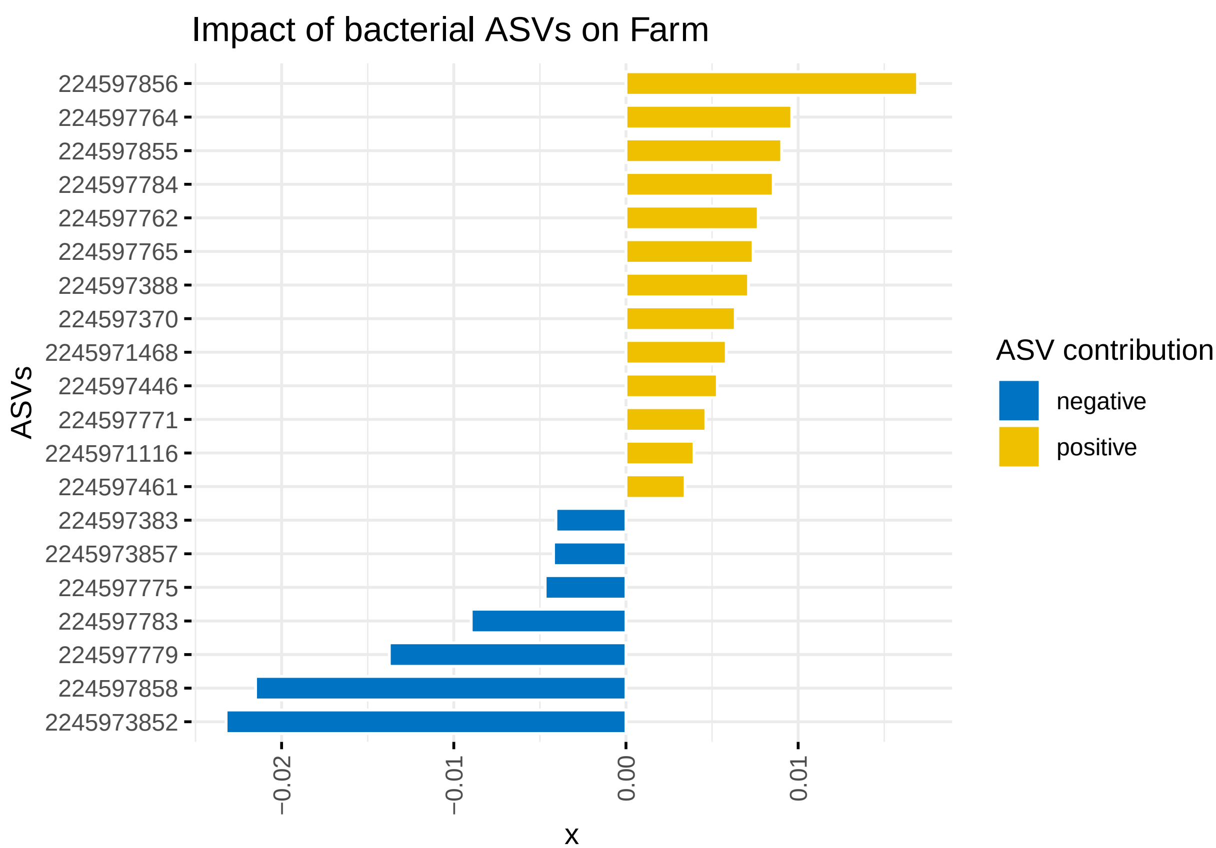
```
          palette = "jco",            # jco journal color palett. see ?ggpar
          sort.val = "asc",           # Sort the value in ascending order
          sort.by.groups = FALSE,     # Don't sort inside each group
          x.text.angle = 90,          # Rotate vertically x axis texts
          xlab = "ASVs",
          legend.title = "ASV contribution",
          title = "Impact of bacterial ASVs on Stable",
          rotate = TRUE,
          ggtheme = theme_minimal())
```



Farm

```
permanova_farm <- adonis(t(assay(tse, "relabundance")) ~ Farm2, data = colData(tse), permutations = 999

coef <- coefficients(permanova_farm)["Farm21",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                           unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                   levels = c("negative", "positive"))

ggbarplot(df, x = "y", y = "x",
          fill = "contr",            # change fill color by mpg_level
```

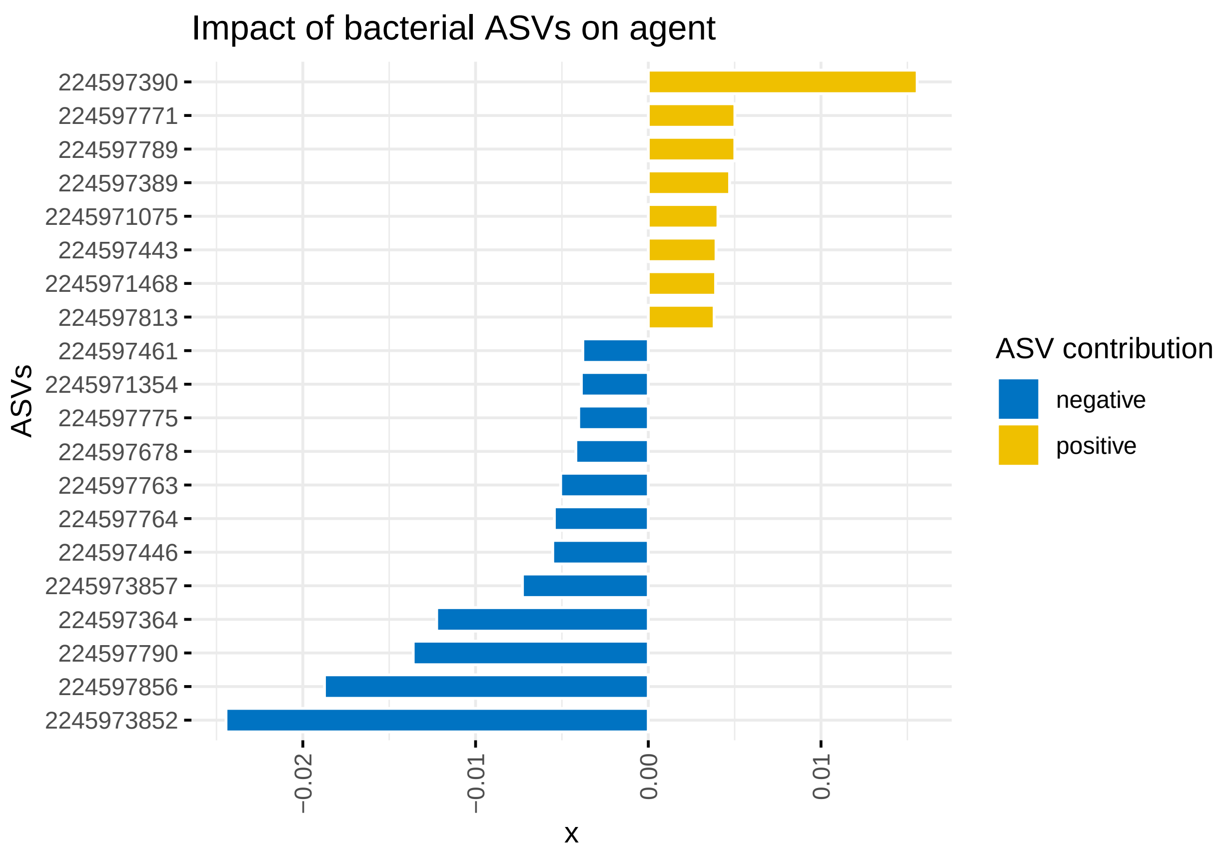
```
          color = "white",            # Set bar border colors to white
          palette = "jco",            # jco journal color palett. see ?ggpar
          sort.val = "asc",           # Sort the value in ascending order
          sort.by.groups = FALSE,     # Don't sort inside each group
          x.text.angle = 90,          # Rotate vertically x axis texts
          xlab = "ASVs",
          legend.title = "ASV contribution",
          title = "Impact of bacterial ASVs on Farm",
          rotate = TRUE,
          ggtheme = theme_minimal())
```



Agent

```
permanova_agent <- adonis(t(assay(tse, "relabundance")) ~ Cox, data = colData(tse), permutations = 9999)

coef <- coefficients(permanova_agent)["Cox1",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                           unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                   levels = c("negative", "positive"))

ggbarplot(df, x = "y", y = "x",
```

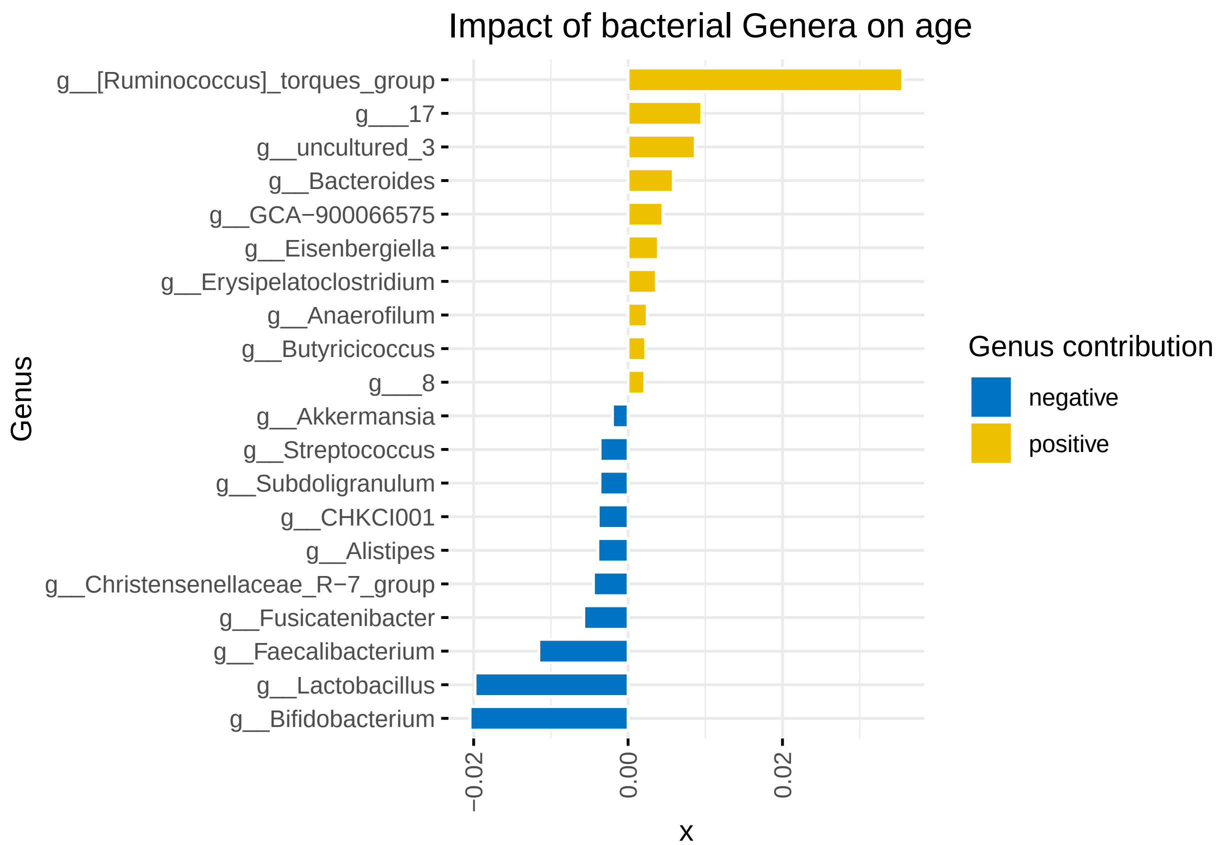
```r
         fill = "contr",             # change fill color by mpg_level
         color = "white",              # Set bar border colors to white
         palette = "jco",              # jco journal color palett. see ?ggpar
         sort.val = "asc",             # Sort the value in ascending order
         sort.by.groups = FALSE,       # Don't sort inside each group
         x.text.angle = 90,            # Rotate vertically x axis texts
         xlab = "ASVs",
         legend.title = "ASV contribution",
         title = "Impact of bacterial ASVs on agent",
         rotate = TRUE,
         ggtheme = theme_minimal())
```



Same plots but for genera - Age

```r
permanova_age <- adonis(t(assay(tse_genus, "relabundance")) ~ Age, data = colData(tse_genus), permutati

coef <- coefficients(permanova_age)["Age1",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                           unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                   levels = c("negative", "positive"))
```

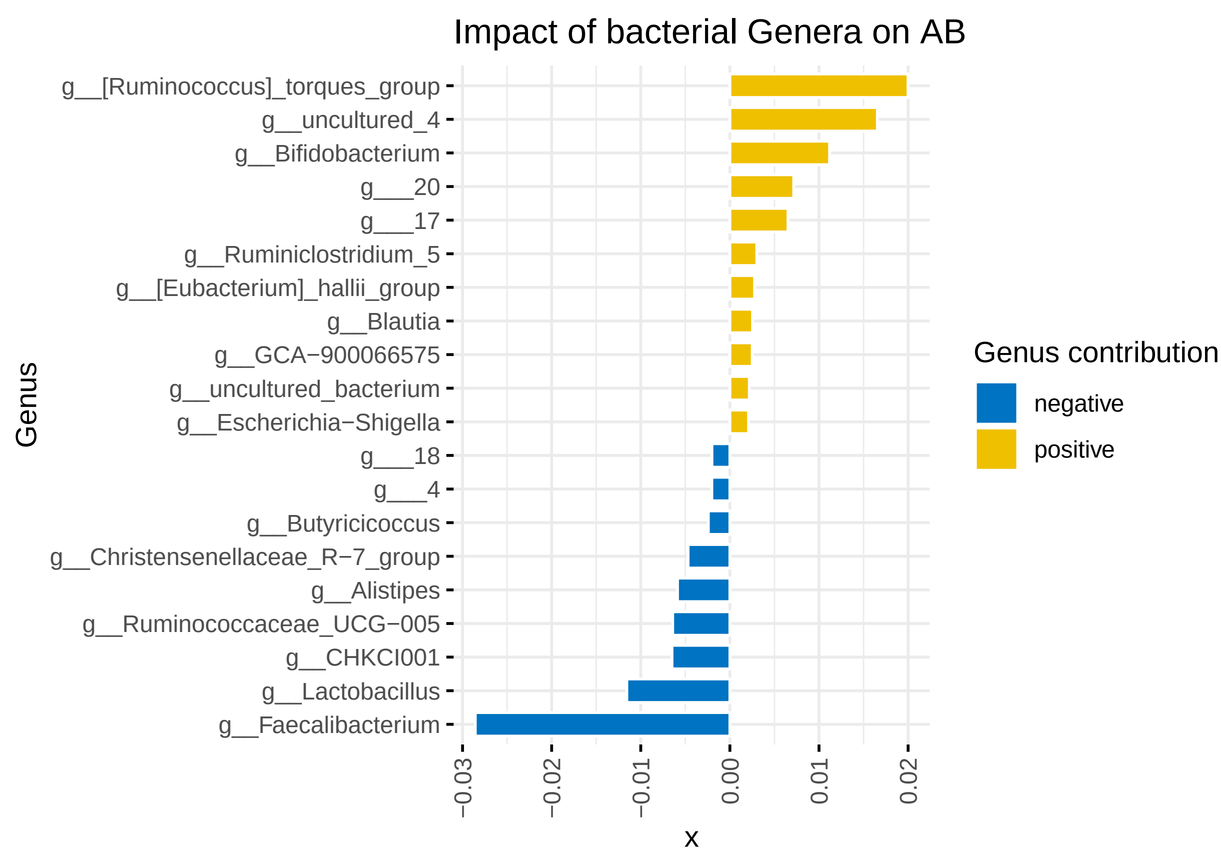
```r
ggbarplot(df, x = "y", y = "x",
          fill = "contr",            # change fill color by mpg_level
          color = "white",             # Set bar border colors to white
          palette = "jco",             # jco journal color palett. see ?ggpar
          sort.val = "asc",            # Sort the value in ascending order
          sort.by.groups = FALSE,      # Don't sort inside each group
          x.text.angle = 90,           # Rotate vertically x axis texts
          xlab = "Genus",
          legend.title = "Genus contribution",
          title = "Impact of bacterial Genera on age",
          rotate = TRUE,
          ggtheme = theme_minimal())
```



Antibiotic treatment

```r
permanova_AB <- adonis(t(assay(tse_genus, "relabundance")) ~ AB, data = colData(tse_genus), permutations

coef <- coefficients(permanova_AB)["AB1",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                           unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                   levels = c("negative", "positive"))
```

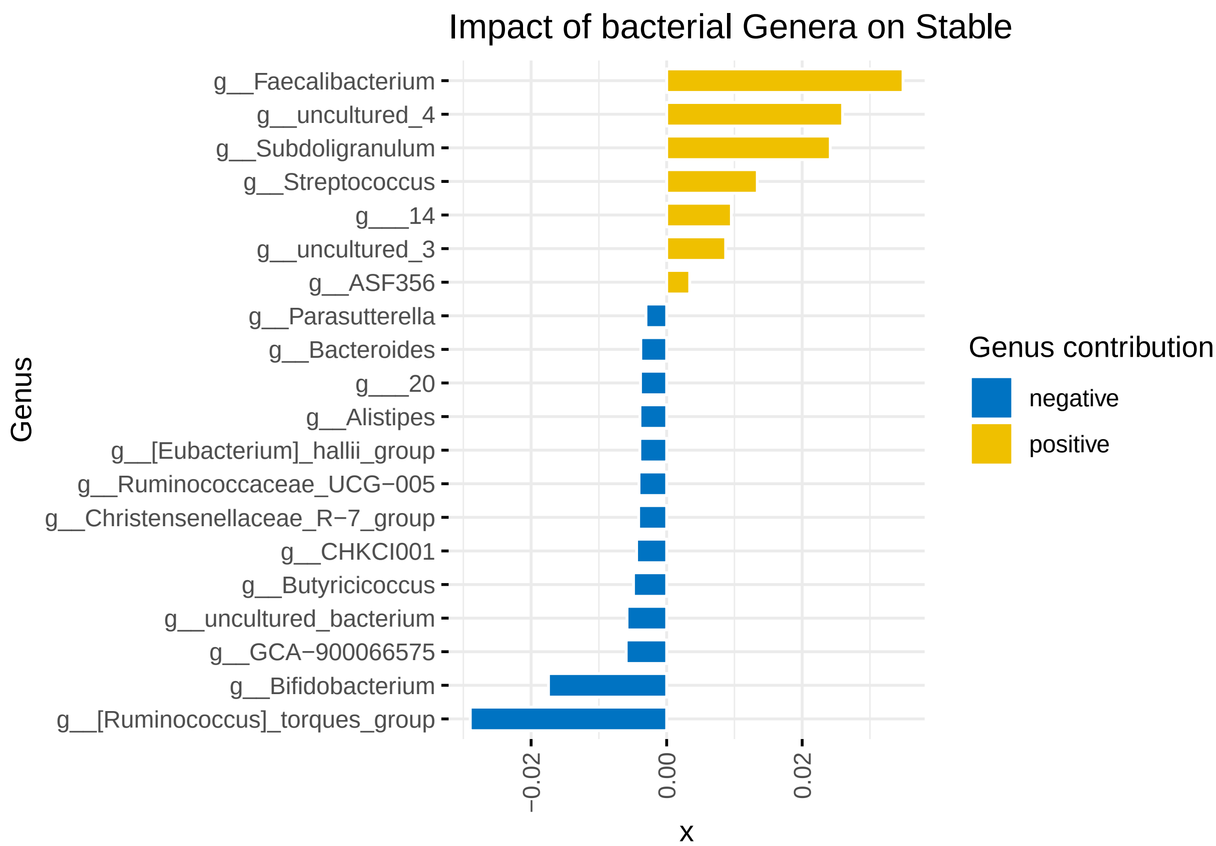
```
ggbarplot(df, x = "y", y = "x",
          fill = "contr",           # change fill color by mpg_level
          color = "white",            # Set bar border colors to white
          palette = "jco",            # jco journal color palett. see ?ggpar
          sort.val = "asc",           # Sort the value in ascending order
          sort.by.groups = FALSE,     # Don't sort inside each group
          x.text.angle = 90,          # Rotate vertically x axis texts
          xlab = "Genus",
          legend.title = "Genus contribution",
          title = "Impact of bacterial Genera on AB",
          rotate = TRUE,
          ggtheme = theme_minimal())
```



Stable

```
permanova_stable <- adonis(t(assay(tse_genus, "relabundance")) ~ Stables, data = colData(tse_genus), pe

coef <- coefficients(permanova_stable)["Stables1",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                           unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                   levels = c("negative", "positive"))
```

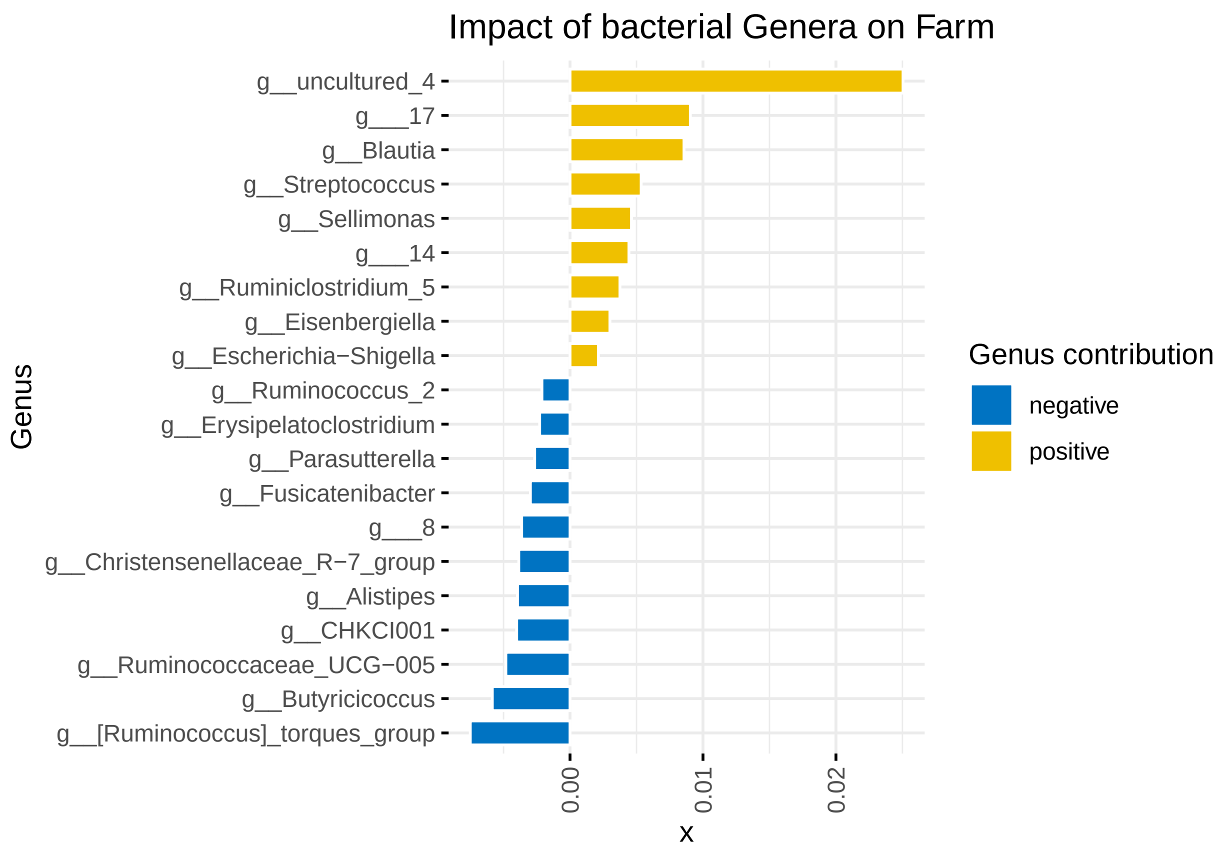
```
ggbarplot(df, x = "y", y = "x",
          fill = "contr",            # change fill color by mpg_level
          color = "white",             # Set bar border colors to white
          palette = "jco",             # jco journal color palett. see ?ggpar
          sort.val = "asc",            # Sort the value in ascending order
          sort.by.groups = FALSE,      # Don't sort inside each group
          x.text.angle = 90,           # Rotate vertically x axis texts
          xlab = "Genus",
          legend.title = "Genus contribution",
          title = "Impact of bacterial Genera on Stable",
          rotate = TRUE,
          ggtheme = theme_minimal())
```



Farm

```
permanova_farm <- adonis(t(assay(tse_genus, "relabundance")) ~ Farm2, data = colData(tse_genus), permuta

coef <- coefficients(permanova_farm)["Farm21",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                           unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                   levels = c("negative", "positive"))
```

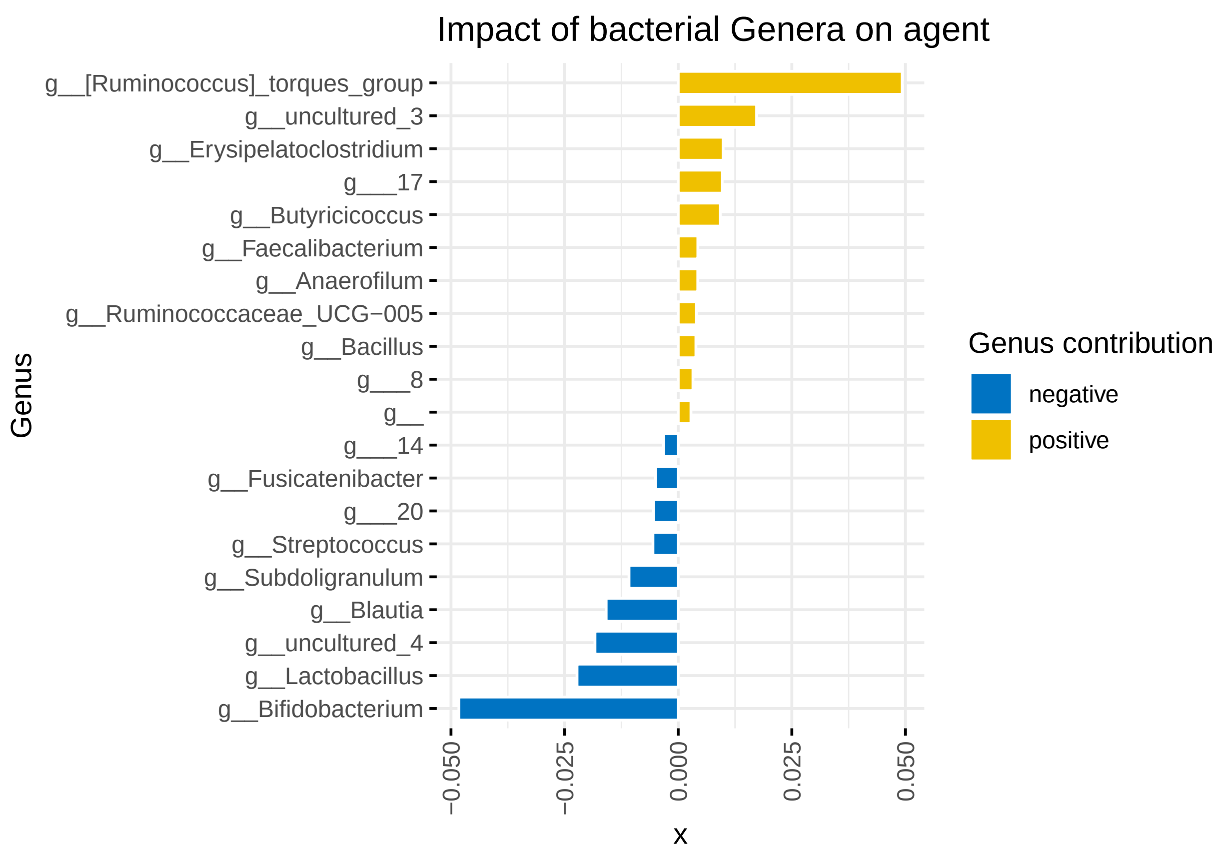
```
ggbarplot(df, x = "y", y = "x",
          fill = "contr",             # change fill color by mpg_level
          color = "white",              # Set bar border colors to white
          palette = "jco",              # jco journal color palett. see ?ggpar
          sort.val = "asc",             # Sort the value in ascending order
          sort.by.groups = FALSE,       # Don't sort inside each group
          x.text.angle = 90,            # Rotate vertically x axis texts
          xlab = "Genus",
          legend.title = "Genus contribution",
          title = "Impact of bacterial Genera on Farm",
          rotate = TRUE,
          ggtheme = theme_minimal())
```



Agent

```
permanova_agent <- adonis(t(assay(tse_genus, "relabundance")) ~ Cox, data = colData(tse_genus), permuta

coef <- coefficients(permanova_agent)["Cox1",]
top.coef <- sort(head(coef[rev(order(abs(coef)))],20))

df = data.frame(x = top.coef,
                y = factor(names(top.coef),
                           unique(names(top.coef))))

df$contr <- factor(ifelse(df$x < 0, "negative", "positive"),
                   levels = c("negative", "positive"))
```

```r
ggbarplot(df, x = "y", y = "x",
          fill = "contr",            # change fill color by mpg_level
          color = "white",             # Set bar border colors to white
          palette = "jco",             # jco journal color palett. see ?ggpar
          sort.val = "asc",            # Sort the value in ascending order
          sort.by.groups = FALSE,      # Don't sort inside each group
          x.text.angle = 90,           # Rotate vertically x axis texts
          xlab = "Genus",
          legend.title = "Genus contribution",
          title = "Impact of bacterial Genera on agent",
          rotate = TRUE,
          ggtheme = theme_minimal())
```



checking homogeneity condition - bray-curtis ANOVAs are performed on betadispers of our rel abund data to test whether groups are more variable than others

```r
# Bray
ps.rel = microbiome::transform(subset16S, "compositional")
meta = meta(ps.rel)
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$Age))
```

```
## Analysis of Variance Table
##
## Response: Distances
##             Df  Sum Sq  Mean Sq F value    Pr(>F)
```

```
## Groups      1 0.04882 0.048824  12.036 0.0007295 ***
## Residuals 118 0.47868 0.004057
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$AB))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq  Mean Sq F value  Pr(>F)
## Groups      1 0.03423 0.034229  8.4594 0.00434 **
## Residuals 118 0.47746 0.004046
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$Farm2))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq   Mean Sq F value  Pr(>F)
## Groups      3 0.05386 0.0179546   3.488 0.01805 *
## Residuals 116 0.59712 0.0051476
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$Stables))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq   Mean Sq F value  Pr(>F)
## Groups      9 0.10294 0.0114374  2.2578 0.02333 *
## Residuals 110 0.55723 0.0050658
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$Cox))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq   Mean Sq F value  Pr(>F)
## Groups      3 0.05437 0.0181226  3.5909 0.01585 *
## Residuals 116 0.58544 0.0050469
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$Researcher))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq   Mean Sq F value    Pr(>F)
## Groups      4 0.11864 0.0296606  6.4411 0.0001031 ***
## Residuals 115 0.52956 0.0046049
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$LitterType)) # homogeneous
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq   Mean Sq F value Pr(>F)
## Groups      2 0.00394 0.0019691  0.3935 0.6756
## Residuals 117 0.58548 0.0050041
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$Gender)) # homogeneous
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq   Mean Sq F value Pr(>F)
## Groups      1 0.00107 0.0010715  0.2599 0.6111
## Residuals 118 0.48643 0.0041223
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$FlockSize))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq   Mean Sq F value    Pr(>F)
## Groups      5 0.10963 0.0219269  4.6166 0.0007136 ***
## Residuals 114 0.54145 0.0047496
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$AgeParentStock)) # homogeneous
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq   Mean Sq F value  Pr(>F)
## Groups      4 0.04865 0.0121630   2.213 0.07188 .
## Residuals 115 0.63206 0.0054962
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$FeedProducent))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq  Mean Sq F value    Pr(>F)
## Groups      2 0.06978 0.034891  7.7777 0.0006739 ***
## Residuals 117 0.52487 0.004486
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel))), meta$FeedType))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq  Mean Sq F value    Pr(>F)
## Groups      1 0.04882 0.048824  12.036 0.0007295 ***
## Residuals 118 0.47868 0.004057
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
# Jaccard
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$Age))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df   Sum Sq   Mean Sq F value    Pr(>F)
## Groups      1 0.023087 0.0230874  12.572 0.0005626 ***
## Residuals 118 0.216706 0.0018365
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$AB))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df   Sum Sq   Mean Sq F value   Pr(>F)
## Groups      1 0.022032 0.0220319  12.296 0.000643 ***
## Residuals 118 0.211439 0.0017919
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$Farm2))
```

```
## Analysis of Variance Table
##
## Response: Distances
```

```
##            Df   Sum Sq   Mean Sq F value  Pr(>F)
## Groups      3 0.027311 0.0091035  3.7252 0.01337 *
## Residuals 116 0.283478 0.0024438
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$Stables))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df   Sum Sq   Mean Sq F value  Pr(>F)
## Groups      9 0.046992 0.0052213  2.1071 0.03471 *
## Residuals 110 0.272580 0.0024780
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$Researcher))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df  Sum Sq   Mean Sq F value    Pr(>F)
## Groups      4 0.10745 0.0268626   12.64 1.474e-08 ***
## Residuals 115 0.24439 0.0021251
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$LitterType)) # homogeneous
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df   Sum Sq    Mean Sq F value Pr(>F)
## Groups      2 0.000853 0.00042627  0.1859 0.8306
## Residuals 117 0.268245 0.00229269
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$Gender)) # homogeneous
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df   Sum Sq   Mean Sq F value Pr(>F)
## Groups      1 0.000528 0.0005283  0.2968 0.5869
## Residuals 118 0.210023 0.0017799
```

```r
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$FlockSize))
```

```
## Analysis of Variance Table
##
```

```
## Response: Distances
##            Df   Sum Sq  Mean Sq F value    Pr(>F)
## Groups      5 0.067558 0.013512  6.0427 5.345e-05 ***
## Residuals 114 0.254905 0.002236
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$AgeParentStock)) # homogeneou
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df   Sum Sq   Mean Sq F value  Pr(>F)
## Groups      4 0.022427 0.0056068  2.1203 0.08273 .
## Residuals 115 0.304107 0.0026444
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$FeedProducent))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df   Sum Sq   Mean Sq F value    Pr(>F)
## Groups      2 0.037045 0.0185225   8.975 0.0002365 ***
## Residuals 117 0.241463 0.0020638
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(betadisper(vegdist(t(abundances(ps.rel)), method = "jaccard"), meta$FeedType))
```

```
## Analysis of Variance Table
##
## Response: Distances
##            Df   Sum Sq   Mean Sq F value    Pr(>F)
## Groups      1 0.023087 0.0230874  12.572 0.0005626 ***
## Residuals 118 0.216706 0.0018365
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# group variances are not homogenous in most cases, so there are differences in variances between group

# Tukey tests can be performed to see if and which groups differ in relation to variance

TukeyHSD(betadisper(vegdist(t(abundances(ps.rel))), meta$Farm2))
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = distances ~ group, data = df)
##
```

```
## $group
##                    diff         lwr          upr     p adj
## Farm2-Farm1 -0.01283746 -0.05959222  0.033917288 0.8906792
## Farm3-Farm1 -0.06128653 -0.11527427 -0.007298795 0.0193219
## Farm4-Farm1 -0.02958711 -0.08357485  0.024400627 0.4842422
## Farm3-Farm2 -0.04844907 -0.09520382 -0.001694317 0.0391860
## Farm4-Farm2 -0.01674965 -0.06350440  0.030005106 0.7867504
## Farm4-Farm3  0.03169942 -0.02228831  0.085687160 0.4227048
```

```
# different way of calculating homogeneity, permutation tests, null = no difference in dispersion betwe
permutest(betadisper(vegdist(t(abundances(ps.rel))), meta$Age), pairwise = TRUE)
```

```
##
## Permutation test for homogeneity of multivariate dispersions
## Permutation: free
## Number of permutations: 999
##
## Response: Distances
##            Df  Sum Sq  Mean Sq      F N.Perm Pr(>F)
## Groups      1 0.04882 0.048824 12.036    999  0.001 ***
## Residuals 118 0.47868 0.004057
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Pairwise comparisons:
## (Observed p-value below diagonal, permuted p-value above diagonal)
##            14    35
## 14            0.001
## 35 0.00072948
```

```
permutest(betadisper(unifrac.dist, metadf$Age), pairwise = TRUE) # looks like unifrac distances are hom
```

```
##
## Permutation test for homogeneity of multivariate dispersions
## Permutation: free
## Number of permutations: 999
##
## Response: Distances
##            Df   Sum Sq   Mean Sq      F N.Perm Pr(>F)
## Groups      1 0.002189 0.0021888 0.8904    999  0.336
## Residuals 118 0.290075 0.0024583
##
## Pairwise comparisons:
## (Observed p-value below diagonal, permuted p-value above diagonal)
##        14    35
## 14        0.343
## 35 0.3473
```

```
permutest(betadisper(unifrac.dist, metadf$AB), pairwise = TRUE) # not for AB though
```

```
##
## Permutation test for homogeneity of multivariate dispersions
```

```
## Permutation: free
## Number of permutations: 999
##
## Response: Distances
##            Df   Sum Sq   Mean Sq      F N.Perm Pr(>F)
## Groups      1 0.016272 0.0162721 7.5077    999  0.013 *
## Residuals 118 0.255751 0.0021674
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Pairwise comparisons:
## (Observed p-value below diagonal, permuted p-value above diagonal)
##            no   yes
## no            0.012
## yes 0.0070982
```

```
permutest(betadisper(bray.dist, metadf$Age), pairwise = TRUE) # there are differences in P value with o
```

```
##
## Permutation test for homogeneity of multivariate dispersions
## Permutation: free
## Number of permutations: 999
##
## Response: Distances
##            Df  Sum Sq  Mean Sq      F N.Perm Pr(>F)
## Groups      1 0.04882 0.048824 12.036    999  0.002 **
## Residuals 118 0.47868 0.004057
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Pairwise comparisons:
## (Observed p-value below diagonal, permuted p-value above diagonal)
##            14    35
## 14            0.002
## 35 0.00072948
```

SIMPER - to save time, analyses are not rerun for Rmarkdown, but earlier results are loaded we'll use MT as abbreviation for metataxonomics instead of 16s since R does not like its objects starting with numbers

```
source("../Results/Scripts/Steinberger_scripts/simper_pretty.r")
source("../Results/Scripts/Steinberger_scripts/R_krusk.r")

#Age

#simper.pretty(otu_table(subset16S), metrics = sample_data(subset16S), interesting = c("Age"), perc_cut

#MT_age =  data.frame(read.csv("MT_age_clean_simper.csv"))

#kruskal.pretty(otu_table(subset16S), metrics = sample_data(subset16S), csv = MT_age, interesting = c('

KW_MT_age = data.frame(read.csv("MT_Age_krusk_simper.csv"))
KW_MT_age = KW_MT_age[KW_MT_age$fdr_krusk_p.val < 0.05,] # filter out non-significant results, based on
KW_MT_age = KW_MT_age[with(KW_MT_age, order(SIMPER, decreasing = TRUE)),]
```

```r
KW_MT_age$OTU = as.factor(KW_MT_age$OTU)

KW_MT_age %>% mutate_if(is.numeric, format.pval, 2) %>% dplyr::select("SIMPER", "OTU", "fdr_krusk_p.val
  rowwise() %>% mutate(Combined = paste("ASV =", OTU, ", SIMPER =", SIMPER, ", p-value =", fdr_krusk_p.
  dplyr::select(Combined)
```

```
## # A tibble: 3 x 1
## # Rowwise:
##   Combined
##   <chr>
## 1 ASV = 224597762 , SIMPER = 0.035 , p-value = 0.00068
## 2 ASV = 224597390 , SIMPER = 0.028 , p-value = 0.00906
## 3 ASV = 224597789 , SIMPER = 0.018 , p-value = 1.8e-07
```

```r
#AB
#simper.pretty(otu_table(subset16S), metrics = sample_data(subset16S), interesting = c("AB"), perc_cuto

#MT_AB =  data.frame(read.csv("MT_AB_clean_simper.csv"))

#kruskal.pretty(otu_table(subset16S), metrics = sample_data(subset16S), csv = MT_AB, interesting = c('A

KW_MT_AB = data.frame(read.csv("MT_AB_krusk_simper.csv"))
KW_MT_AB = KW_MT_AB[KW_MT_AB$fdr_krusk_p.val < 0.05,] # filter out non-significant results, based on fd
KW_MT_AB = KW_MT_AB[with(KW_MT_AB, order(SIMPER, decreasing = TRUE)),]
KW_MT_AB$OTU = as.factor(KW_MT_AB$OTU)

KW_MT_AB %>% mutate_if(is.numeric, format.pval, 2) %>% dplyr::select("SIMPER", "OTU", "fdr_krusk_p.val"
  rowwise() %>% mutate(Combined = paste("ASV =", OTU, ", SIMPER =", SIMPER, ", p-value =", fdr_krusk_p.
  dplyr::select(Combined)
```

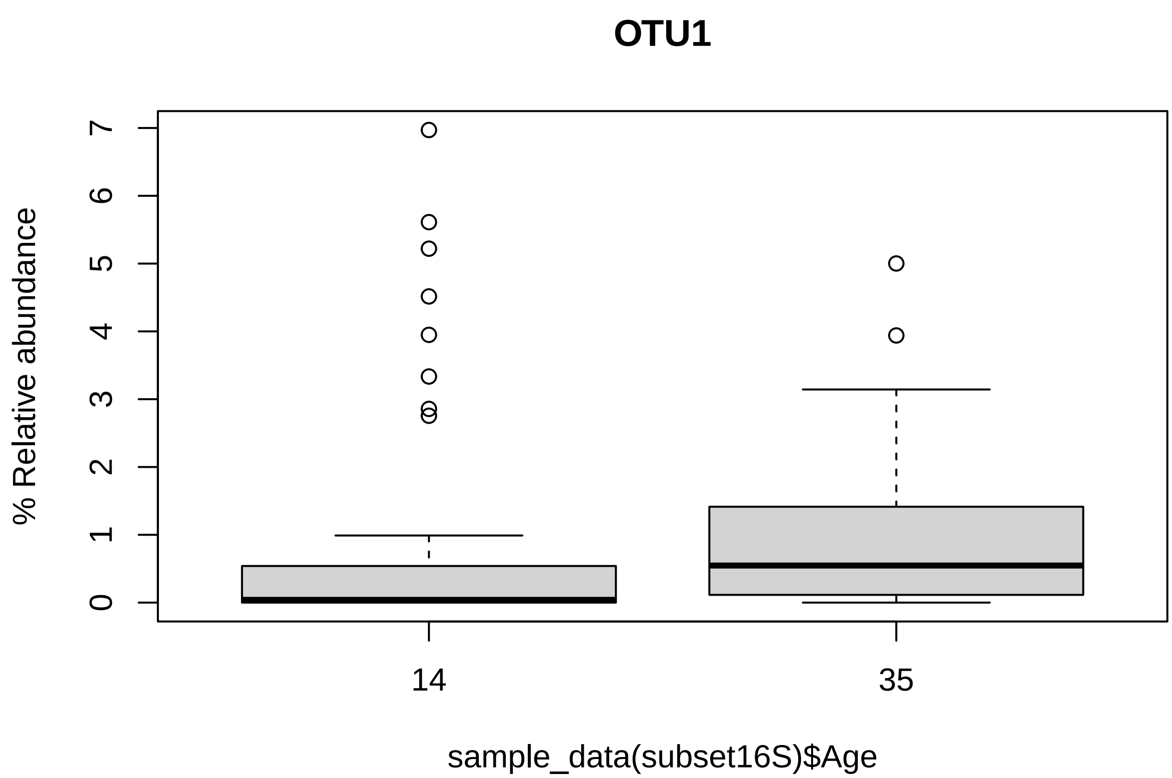
```
## # A tibble: 5 x 1
## # Rowwise:
##   Combined
##   <chr>
## 1 ASV = 224597771 , SIMPER = 0.027 , p-value = 0.0103
## 2 ASV = 2245971468 , SIMPER = 0.015 , p-value = 2.8e-05
## 3 ASV = 224597789 , SIMPER = 0.015 , p-value = 0.0066
## 4 ASV = 224597856 , SIMPER = 0.013 , p-value = 0.0027
## 5 ASV = 224597364 , SIMPER = 0.010 , p-value = 0.0026
```

```r
#Farms - too many comparisons so maybe too extensive for report

#simper.pretty(otu_table(subset16S), metrics = sample_data(subset16S), interesting = c("Farm2"), perc_c

#MT_Farm =  data.frame(read.csv("MT_Farm_clean_simper.csv"))

#kruskal.pretty(otu_table(subset16S), metrics = sample_data(subset16S), csv = MT_Farm, interesting = c(

KW_MT_Farm = data.frame(read.csv("MT_Farm_krusk_simper.csv"))
KW_MT_Farm = KW_MT_Farm[KW_MT_Farm$fdr_krusk_p.val < 0.05,] # filter out non-significant results, based
KW_MT_Farm = KW_MT_Farm[with(KW_MT_Farm, order(SIMPER, decreasing = TRUE)),]
KW_MT_Farm$OTU = as.factor(KW_MT_Farm$OTU)
```

```
KW_MT_Farm %>% mutate_if(is.numeric, format.pval, 2) %>% dplyr::select("Comparison", "SIMPER", "OTU", "
  rowwise() %>% mutate(Combined = paste(Comparison, "ASV =", OTU, ", SIMPER =", SIMPER, ", p-value =",
  dplyr::select(Combined)
```

```
## # A tibble: 28 x 1
## # Rowwise:
##    Combined
##    <chr>
##  1 Farm1_Farm4 ASV = 2245973852 , SIMPER = 0.067 , p-value = 2.0e-06
##  2 Farm2_Farm4 ASV = 2245973852 , SIMPER = 0.066 , p-value = 1.9e-10
##  3 Farm3_Farm4 ASV = 2245973852 , SIMPER = 0.065 , p-value = 2.0e-06
##  4 Farm1_Farm4 ASV = 224597858 , SIMPER = 0.034 , p-value = 0.00081
##  5 Farm2_Farm3 ASV = 224597779 , SIMPER = 0.033 , p-value = 0.02551
##  6 Farm1_Farm3 ASV = 224597779 , SIMPER = 0.032 , p-value = 0.00518
##  7 Farm2_Farm3 ASV = 224597763 , SIMPER = 0.031 , p-value = 0.00038
##  8 Farm2_Farm3 ASV = 224597771 , SIMPER = 0.029 , p-value = 0.00073
##  9 Farm3_Farm4 ASV = 224597771 , SIMPER = 0.025 , p-value = 0.01604
## 10 Farm1_Farm4 ASV = 224597783 , SIMPER = 0.023 , p-value = 0.01605
## # i 18 more rows
```

```
# plots to look at specific ASVs (age)
abund = otu_table(subset16S)/rowSums(otu_table(subset16S))*100
boxplot(unlist(data.frame(abund["224597762"])) ~ sample_data(subset16S)$Age, ylab="% Relative abundance
```



```r
# specific test
kruskal.test(unlist(data.frame(otu_table(subset16S)["224597762"]), use.names = FALSE) ~ sample_data(subs
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  unlist(data.frame(otu_table(subset16S)["224597762"]), use.names = FALSE) by sample_data(subset
## Kruskal-Wallis chi-squared = 15.191, df = 1, p-value = 9.716e-05
```

Clustering

```r
# Trying out different distances, aggregation methods and indices for finding optimal number of clusters

tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)

tse <- transformCounts(tse, method = "relabundance")

assay <- t(assay(tse, "relabundance"))

diss_jaccard <- vegdist(assay, method = "jaccard")

# different aggregation methods and indices will grant different amount of clusters
NbClust(diss = diss_jaccard, distance = NULL, method = "complete", index = "mcclain")$Best.nc # two clu
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          0.0313
```

```r
NbClust(diss = diss_jaccard, distance = NULL, method = "complete", index = "frey")$Best.nc # two cluste
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          2.1845
```

```r
NbClust(diss = diss_jaccard, distance = NULL, method = "complete", index = "cindex")$Best.nc # 15 clust
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          15.000           0.638
```

```r
NbClust(diss = diss_jaccard, distance = NULL, method = "complete", index = "silhouette")$Best.nc # two
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##           2.000           0.086
```

```r
NbClust(diss = diss_jaccard, distance = NULL, method = "complete", index = "dunn")$Best.nc # four clust
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##           4.000           0.763
```

```r
NbClust(diss = diss_jaccard, distance = NULL, method = "ward.D2", index = "silhouette")$Best.nc # 15 cl
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##         15.0000          0.0453
```

```r
NbClust(diss = diss_jaccard, distance = NULL, method = "ward.D", index = "silhouette")$Best.nc # 11 clu
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##         11.0000          0.0448
```

```r
NbClust(diss = diss_jaccard, distance = NULL, method = "single", index = "silhouette")$Best.nc # 15 clu
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##         15.0000          0.0827
```

```r
NbClust(diss = diss_jaccard, distance = NULL, method = "average", index = "silhouette")$Best.nc # 2 clu
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##           2.000           0.086
```

```
NbClust(diss = diss_jaccard, distance = NULL, method = "mcquitty", index = "silhouette")$Best.nc # 2 cl
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##           2.000           0.086
```

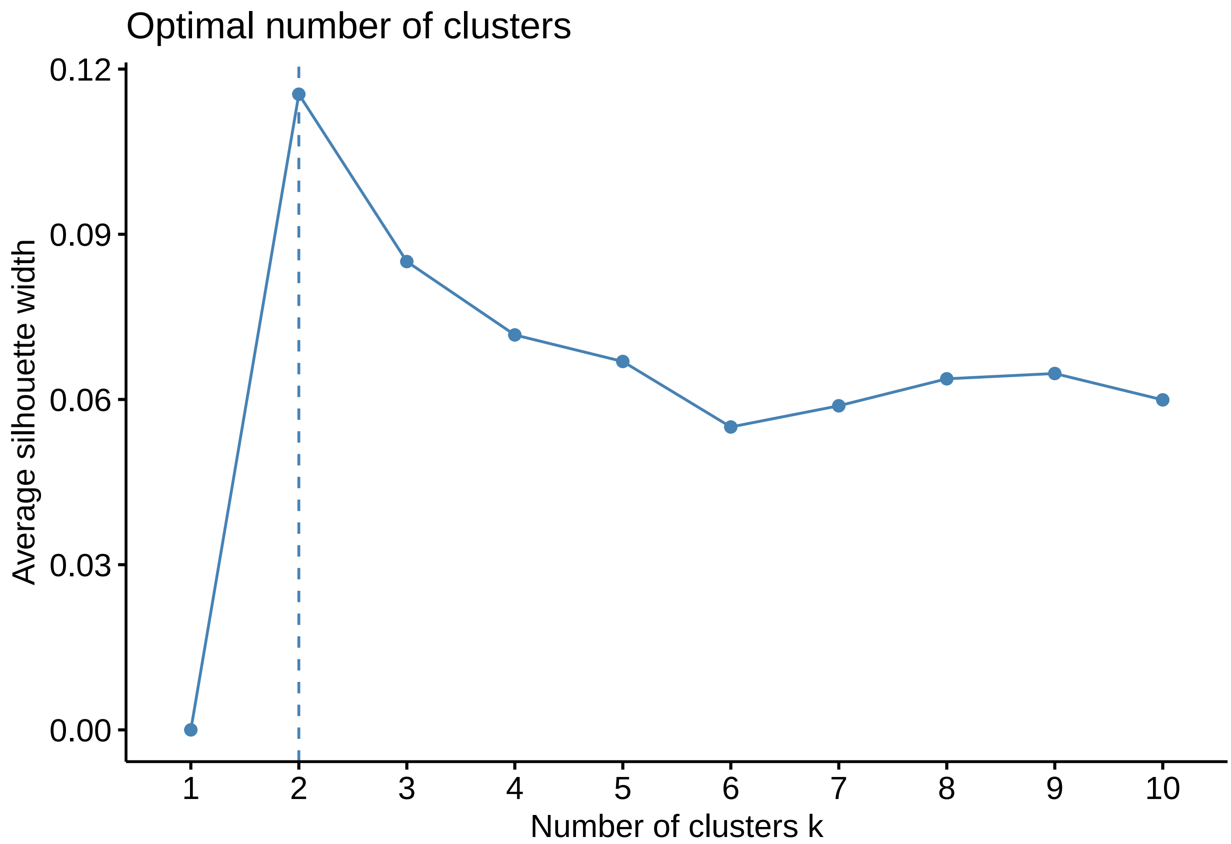
```
NbClust(diss = diss_jaccard, distance = NULL, method = "median", index = "silhouette")$Best.nc # 2 clus
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          0.1194
```

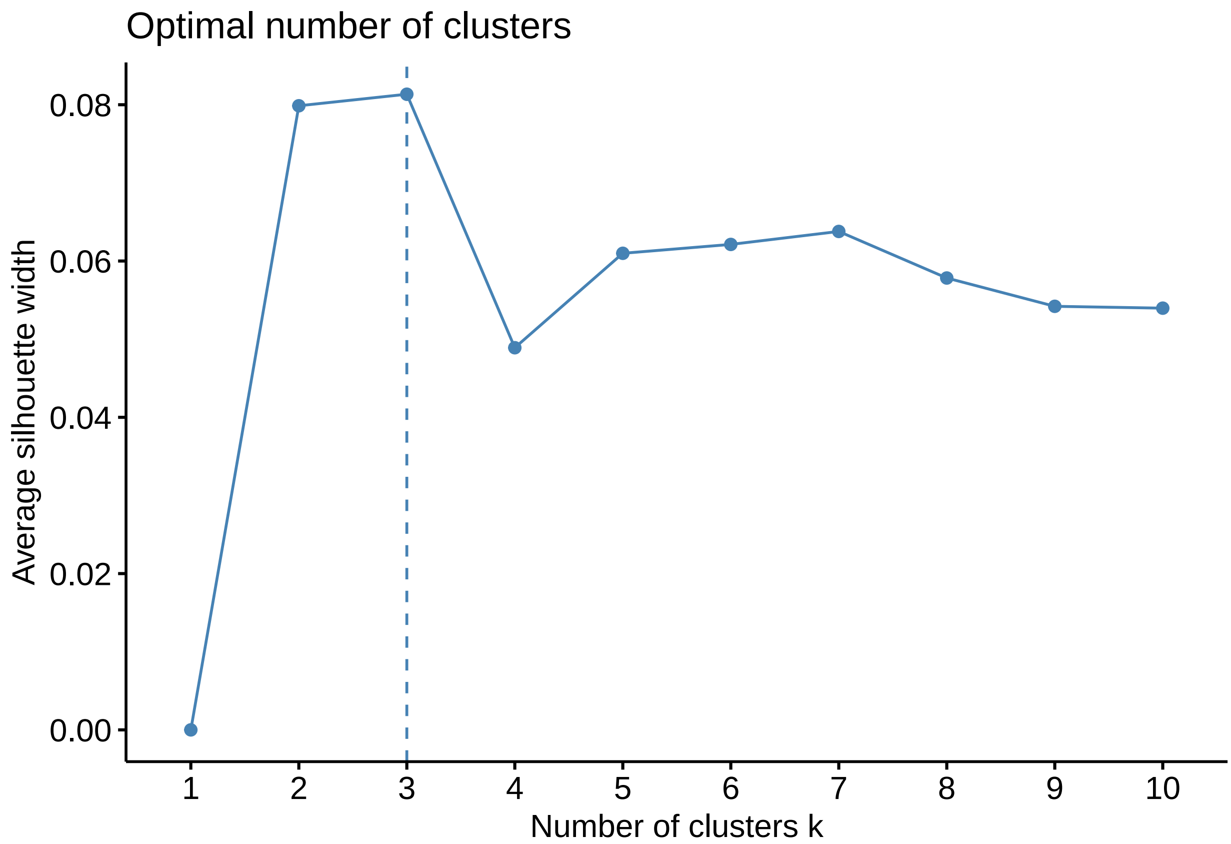
```
NbClust(diss = diss_jaccard, distance = NULL, method = "centroid", index = "silhouette")$Best.nc # 15 c
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##         15.0000          0.1223
```

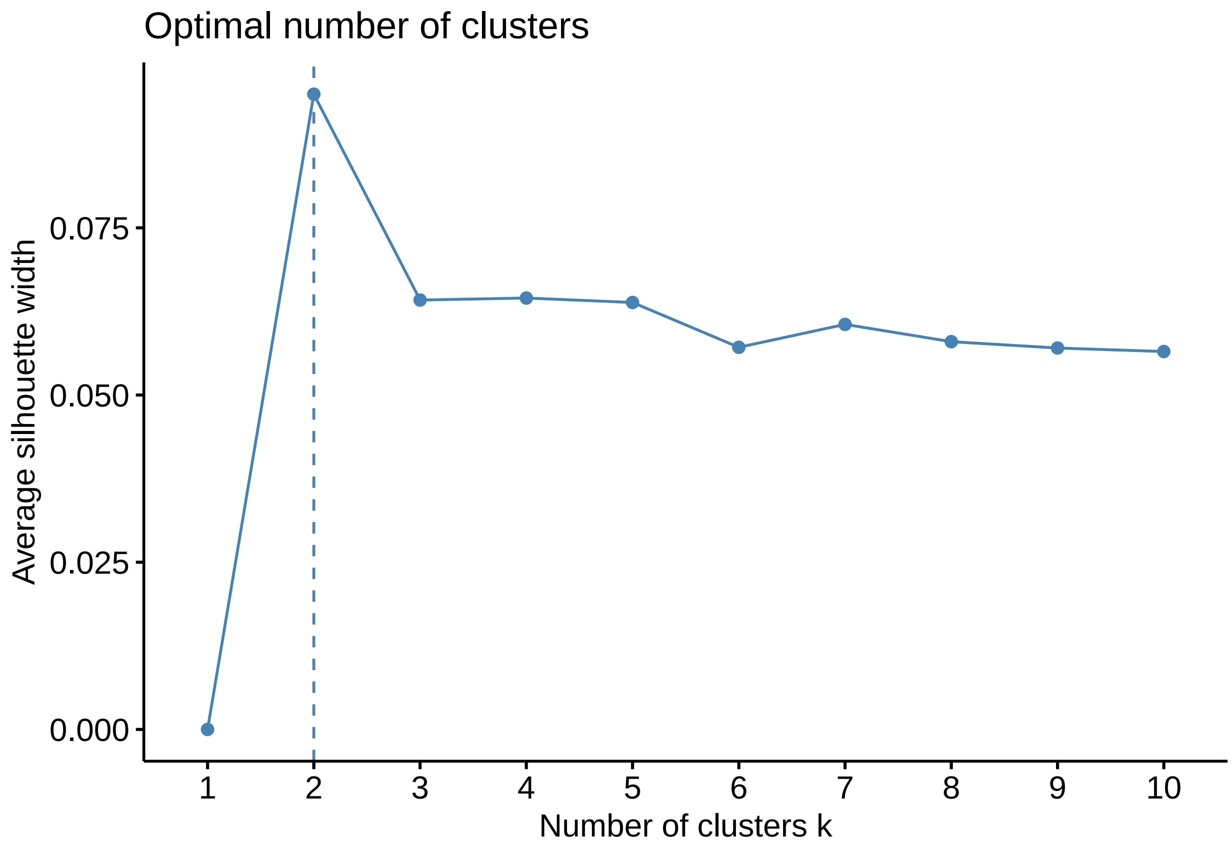
```
# silhouette (ASW), different clustering methods
diss_jaccard <- as.matrix(diss_jaccard)
fviz_nbclust(diss_jaccard, kmeans, method = "silhouette") # 2 seems optimal for k-means
```



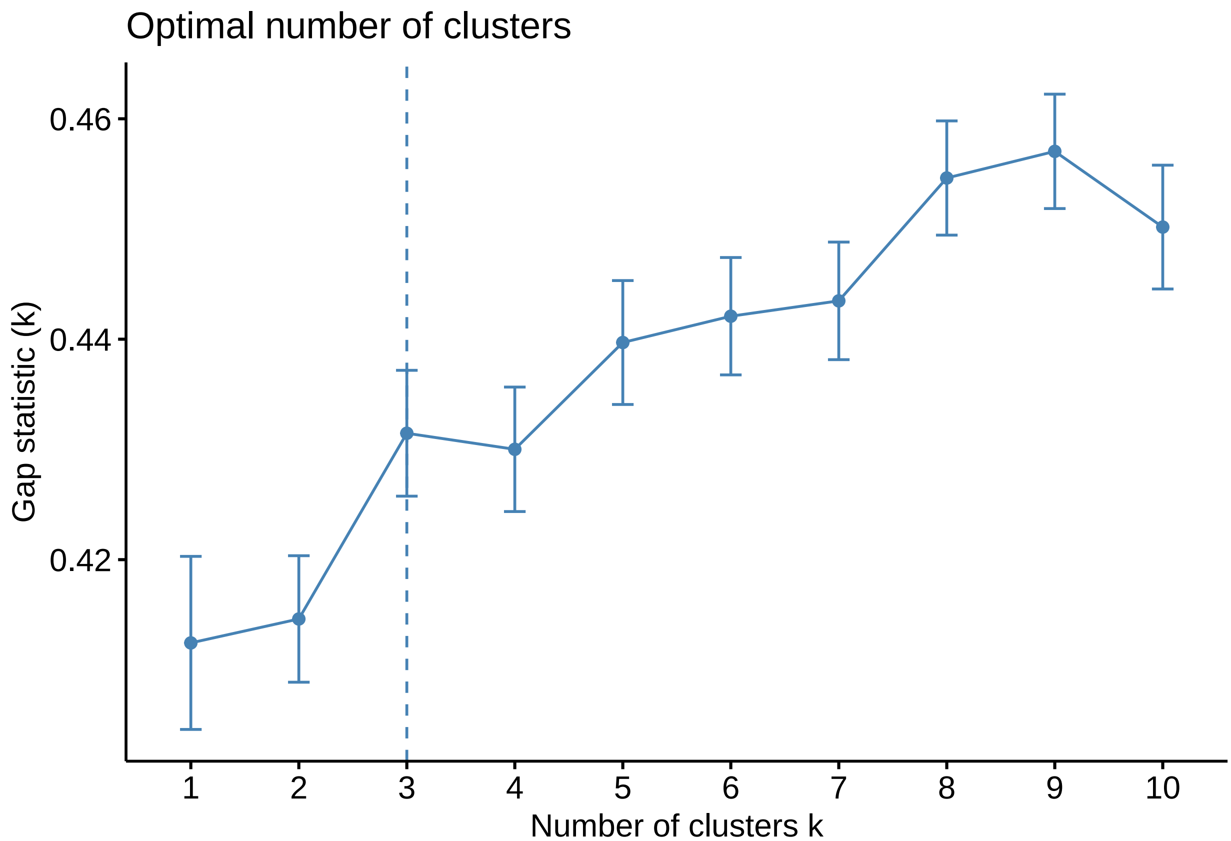

```
fviz_nbclust(diss_jaccard, cluster::pam, method = "silhouette") # 3 seems optimal for PAM
```



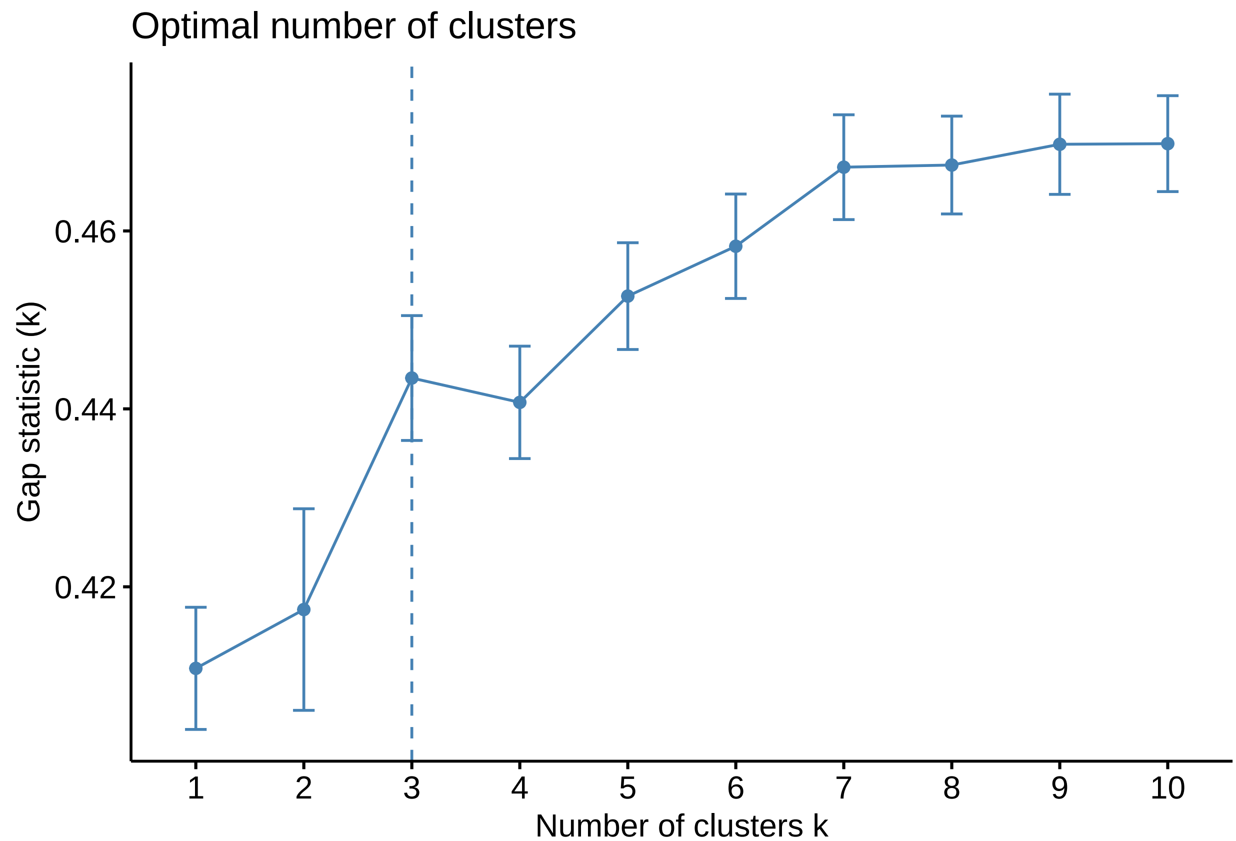

```
fviz_nbclust(diss_jaccard, hcut, method = "silhouette") # 2 seems optimal for hcut
```



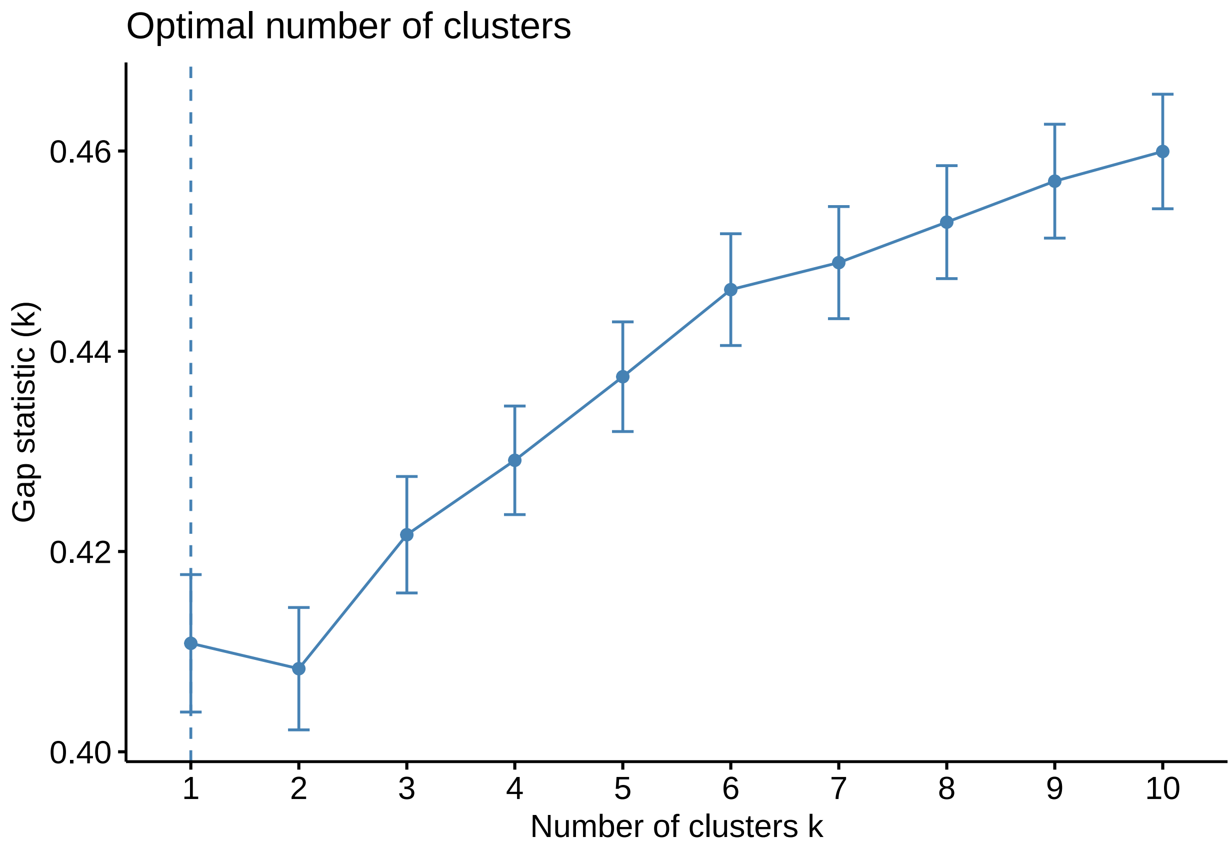

```
fviz_nbclust(diss_jaccard, kmeans, method = "gap_stat") # 3 seems optimal for k-means gap stat
```




```
fviz_nbclust(diss_jaccard, cluster::pam, method = "gap_stat") # 3 seems optimal for PAM gap stat
```




```
fviz_nbclust(diss_jaccard, hcut, method = "gap_stat") # 1 seems optimal for hcut gap stat
```




```
# now, let's repeat this for BC

diss_bray <- vegdist(assay, method = "bray")

NbClust(diss = diss_bray, distance = NULL, method = "complete", index = "mcclain")$Best.nc # two cluste
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          0.0293
```

```
NbClust(diss = diss_bray, distance = NULL, method = "complete", index = "frey")$Best.nc # two clusters
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          2.4419
```

```
NbClust(diss = diss_bray, distance = NULL, method = "complete", index = "cindex")$Best.nc # 5 clusters
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m
```

```
## Number_clusters     Value_Index
##          5.0000          0.5838
```

```
NbClust(diss = diss_bray, distance = NULL, method = "complete", index = "silhouette")$Best.nc # two clu
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          0.1461
```

```
NbClust(diss = diss_bray, distance = NULL, method = "complete", index = "dunn")$Best.nc # four clusters
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          4.0000          0.6277
```

```
NbClust(diss = diss_bray, distance = NULL, method = "ward.D2", index = "silhouette")$Best.nc # 2 cluste
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          0.0955
```

```
NbClust(diss = diss_bray, distance = NULL, method = "ward.D", index = "silhouette")$Best.nc # 2 cluster
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          0.0955
```

```
NbClust(diss = diss_bray, distance = NULL, method = "single", index = "silhouette")$Best.nc # 2 cluster
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          0.1158
```

```
NbClust(diss = diss_bray, distance = NULL, method = "average", index = "silhouette")$Best.nc # 2 cluste
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data m

## Number_clusters     Value_Index
##          2.0000          0.1461
```

```r
NbClust(diss = diss_bray, distance = NULL, method = "mcquitty", index = "silhouette")$Best.nc # 2 clust
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data r

## Number_clusters     Value_Index
##          2.0000          0.1461
```

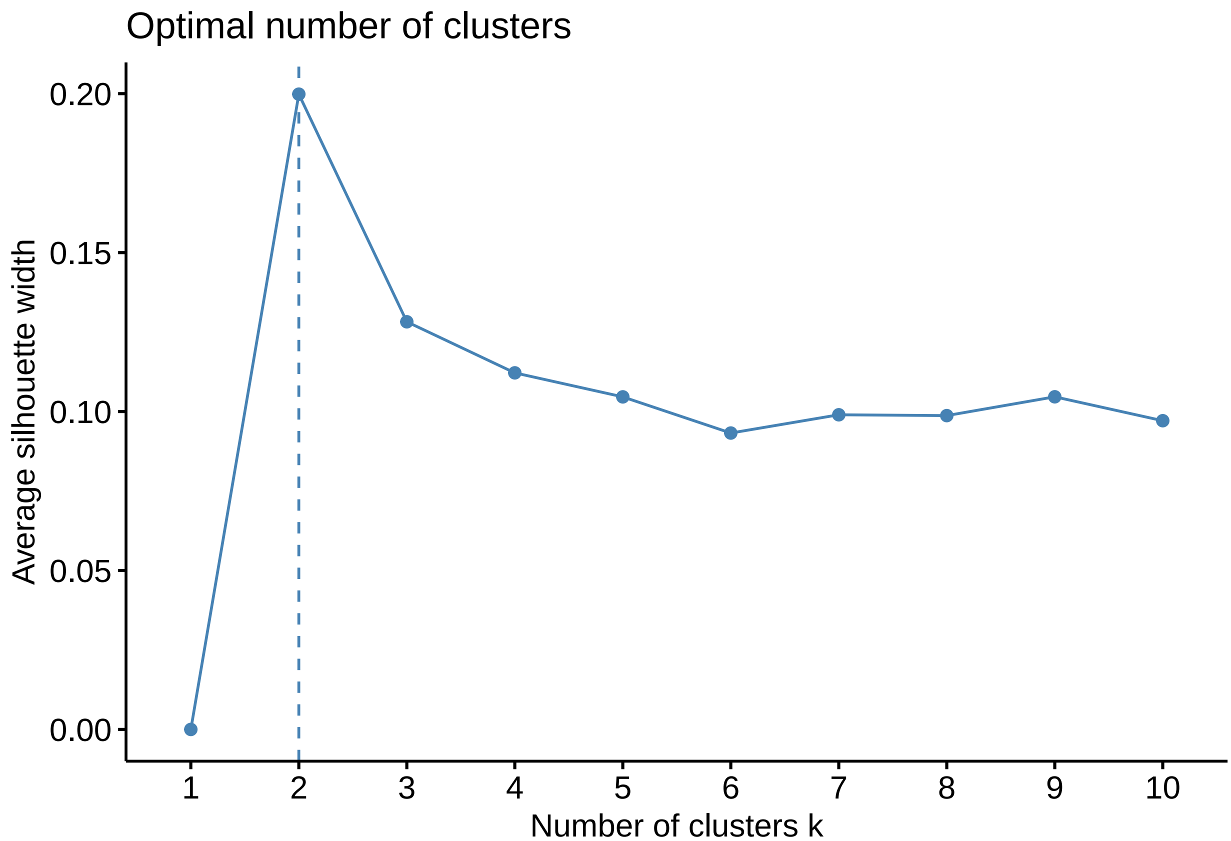
```r
NbClust(diss = diss_bray, distance = NULL, method = "median", index = "silhouette")$Best.nc # 2 clusters
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data r

## Number_clusters     Value_Index
##          2.0000          0.1158
```

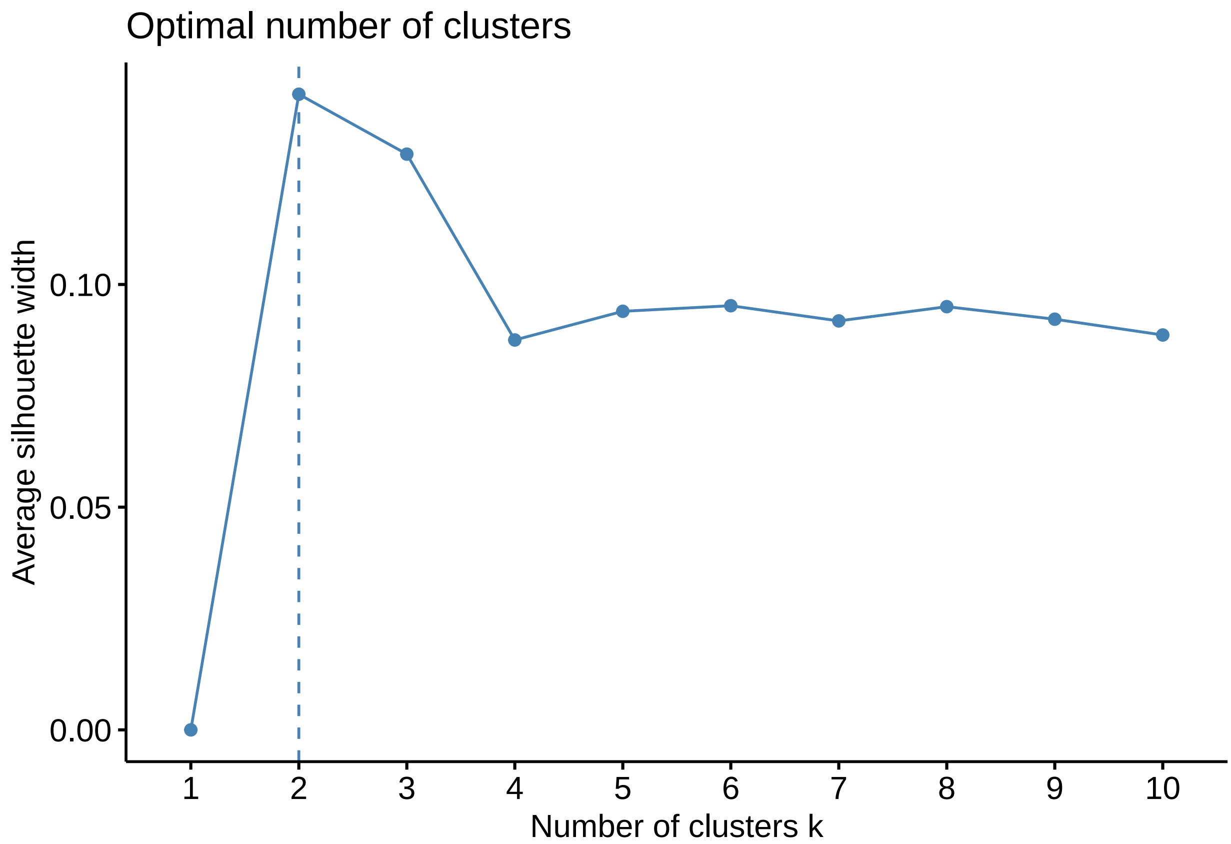
```r
NbClust(diss = diss_bray, distance = NULL, method = "centroid", index = "silhouette")$Best.nc # 2 clust
```

```
##
##  Only frey, mcclain, cindex, sihouette and dunn can be computed. To compute the other indices, data r

## Number_clusters     Value_Index
##          2.0000          0.1972
```

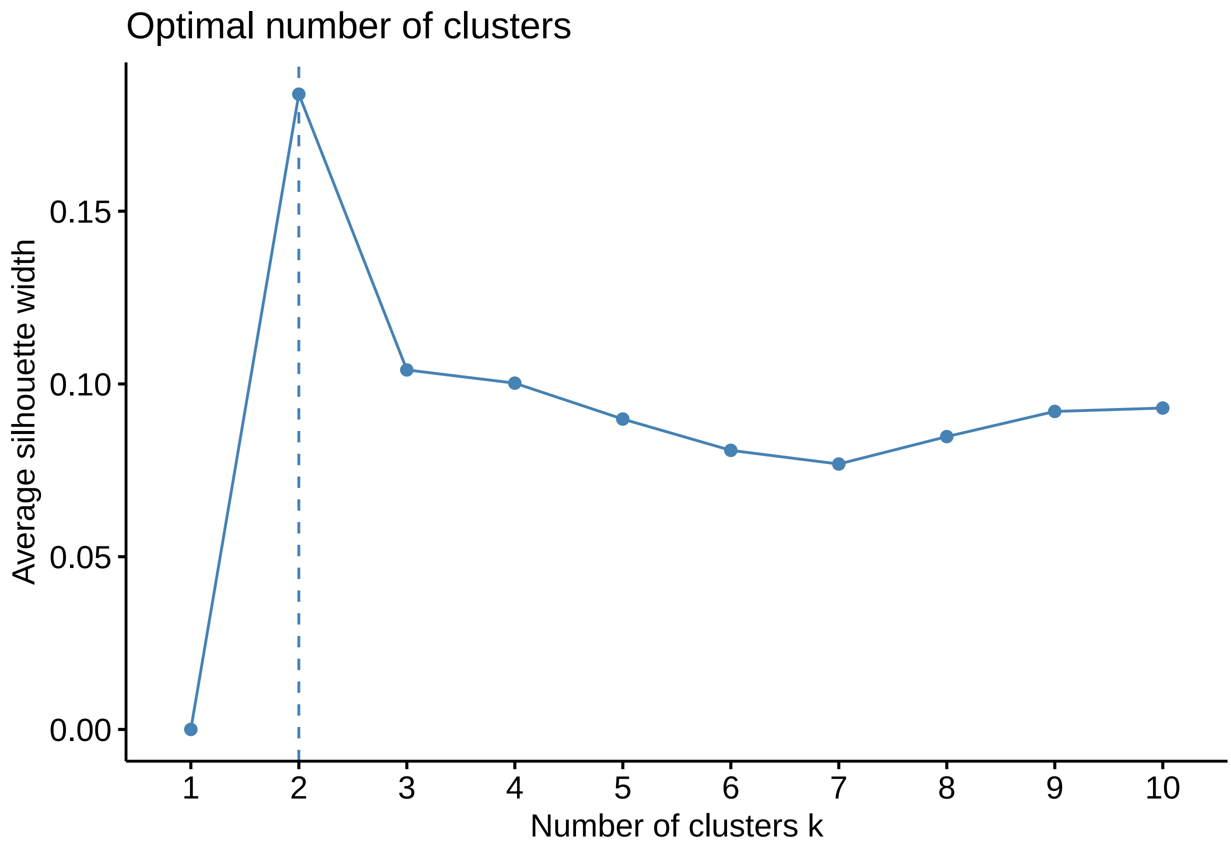
```r
# silhouette (ASW)
diss_bray <- as.matrix(diss_bray)
fviz_nbclust(diss_bray, kmeans, method = "silhouette") # 2 seems optimal
```



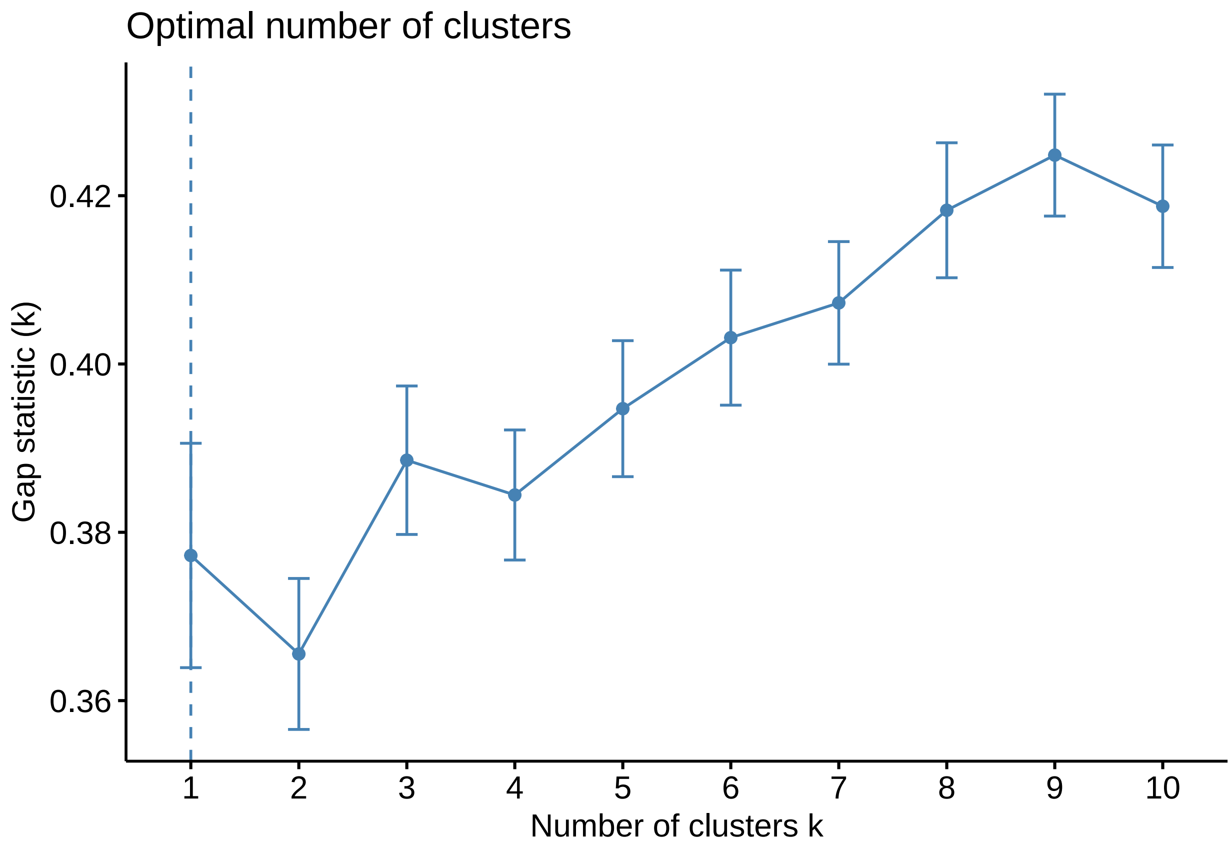

```
fviz_nbclust(diss_bray, cluster::pam, method = "silhouette") # 2 seems optimal for PAM
```



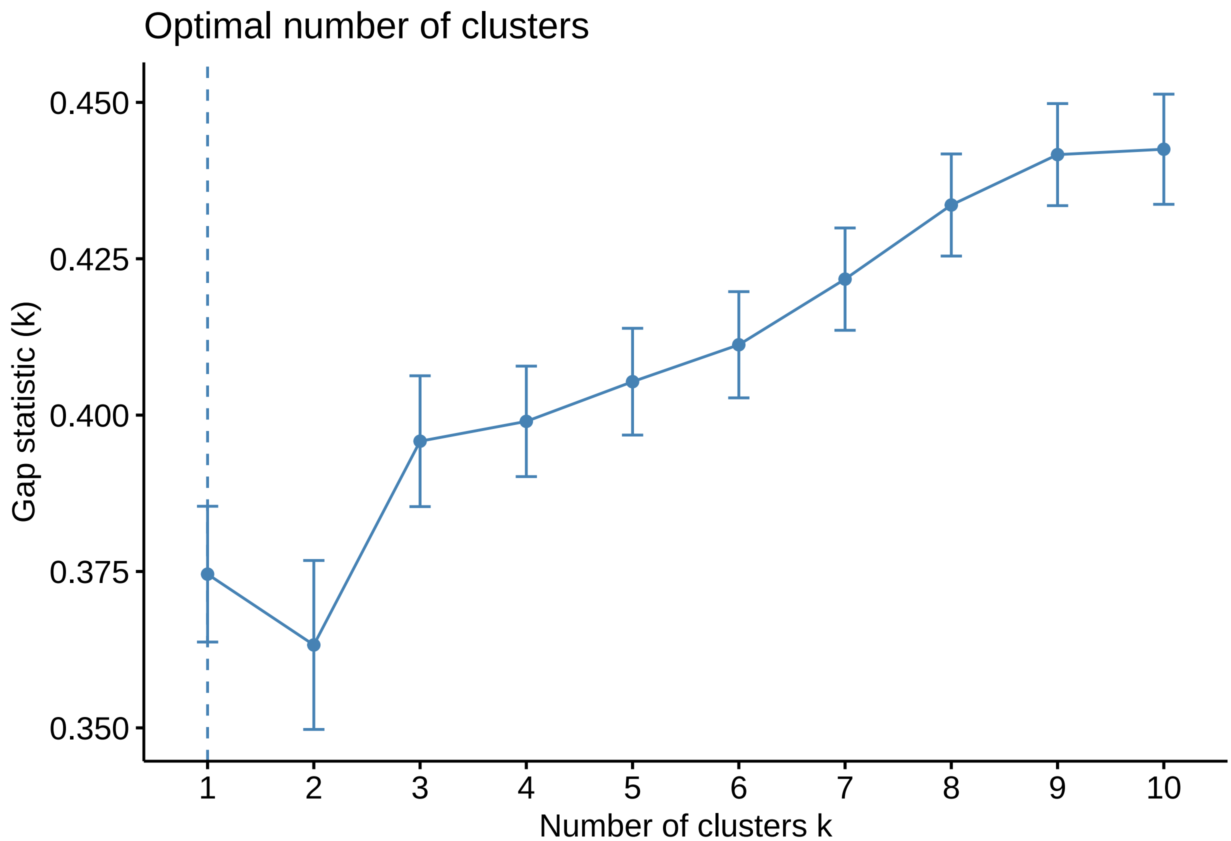

```
fviz_nbclust(diss_bray, hcut, method = "silhouette") # 2 seems optimal for hcut
```



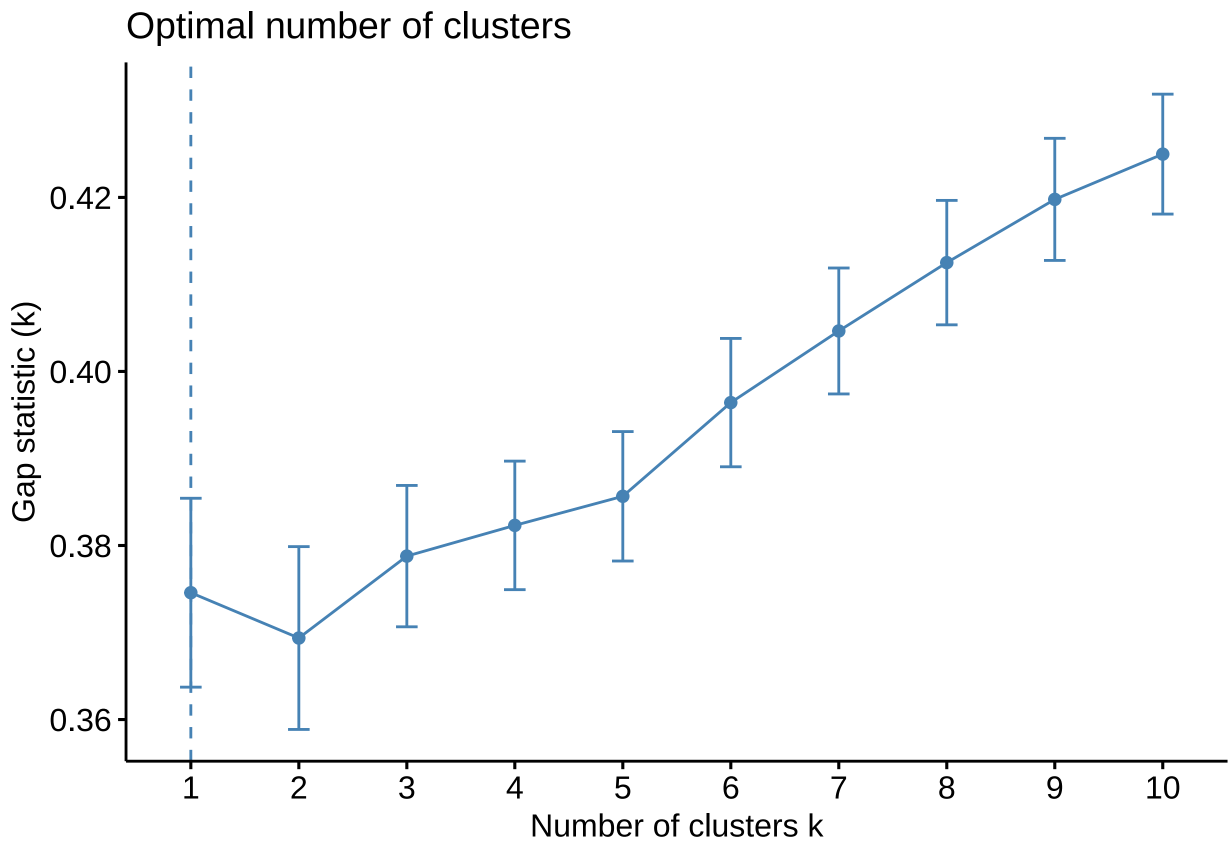

```
fviz_nbclust(diss_bray, kmeans, method = "gap_stat") # 1 seems optimal for k-means gap stat
```



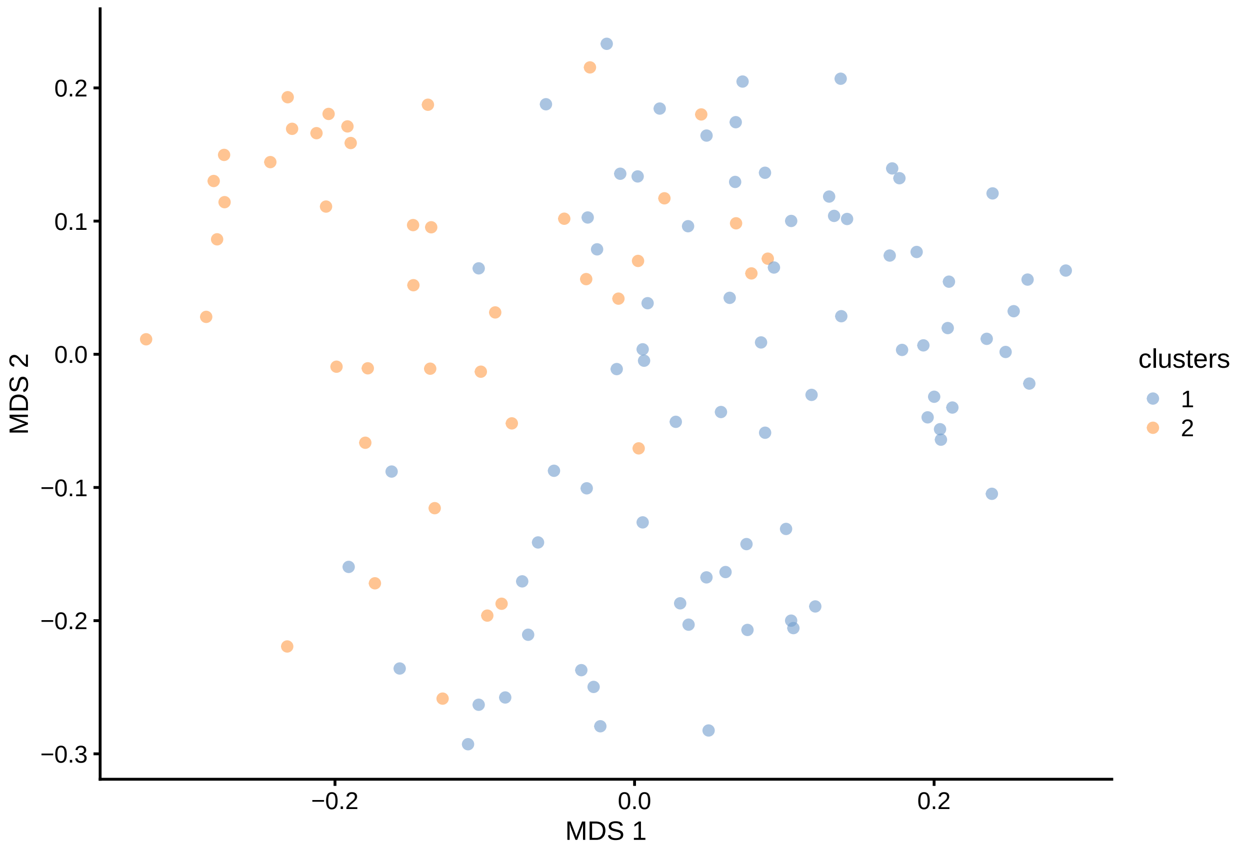

```
fviz_nbclust(diss_bray, cluster::pam, method = "gap_stat") # 1 seems optimal for PAM gap stat
```



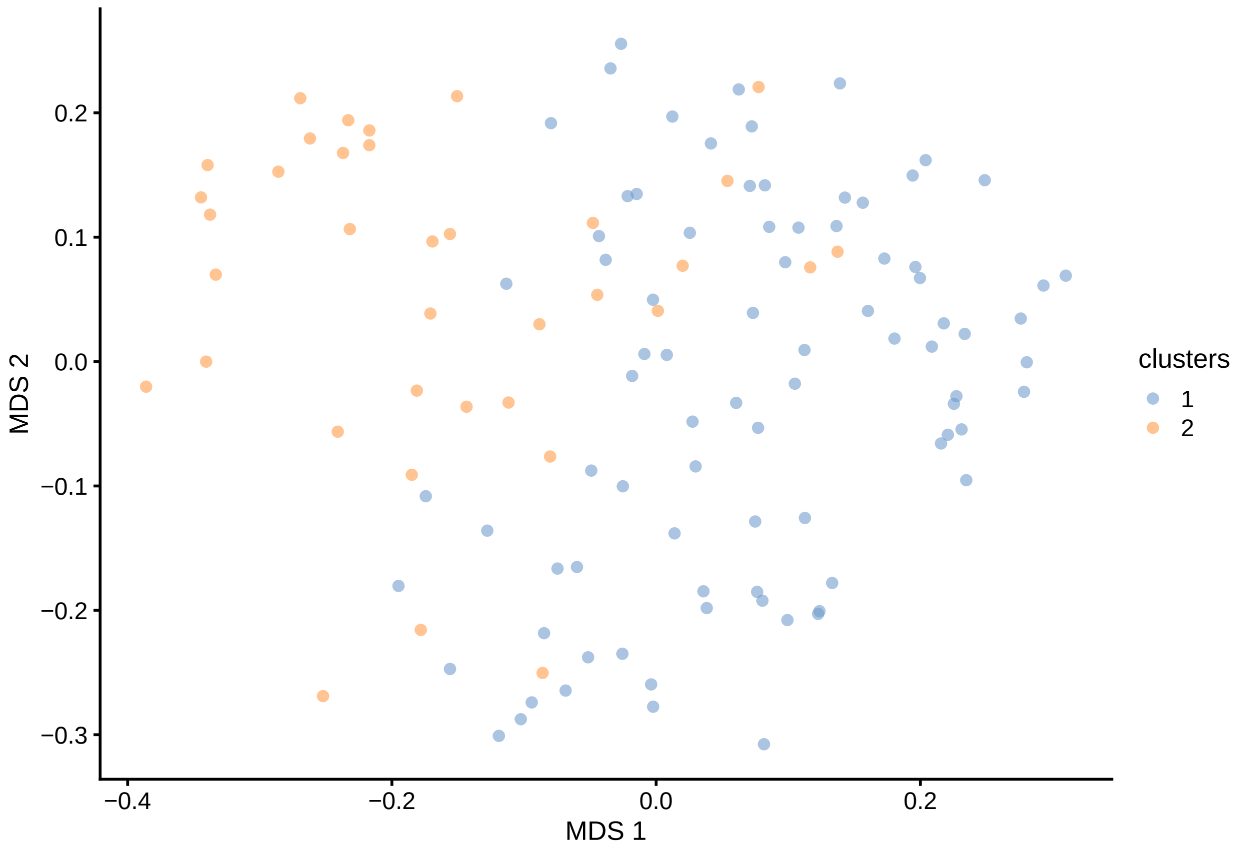

```
fviz_nbclust(diss_bray, hcut, method = "gap_stat") # 1 seems optimal for hcut gap stat
```




```r
# k-means jaccard clusters
set.seed(1337)
km <- kmeans(diss_jaccard, 2, nstart = 25)
colData(tse)$clusters <- as.factor(km$cluster)
tse <- runMDS(tse, assay.type = "relabundance", FUN = vegan::vegdist, method = "jaccard")
plotReducedDim(tse, "MDS", colour_by = "clusters")
```




```r
# k-means bray clusters MDS
set.seed(1337)
km <- kmeans(diss_bray, 2, nstart = 25)
colData(tse)$clusters <- as.factor(km$cluster)
tse <- runMDS(tse, assay.type = "relabundance", FUN = vegan::vegdist, method = "bray")
plotReducedDim(tse, "MDS", colour_by = "clusters")
```




```
# DMM (Laplace approximation) - ASV level
tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)
tse_dmn <- mia::runDMN(tse, name = "DMN", k = 1:7) # calculate most likely number of clusters from 1 to
tse_dmn
```

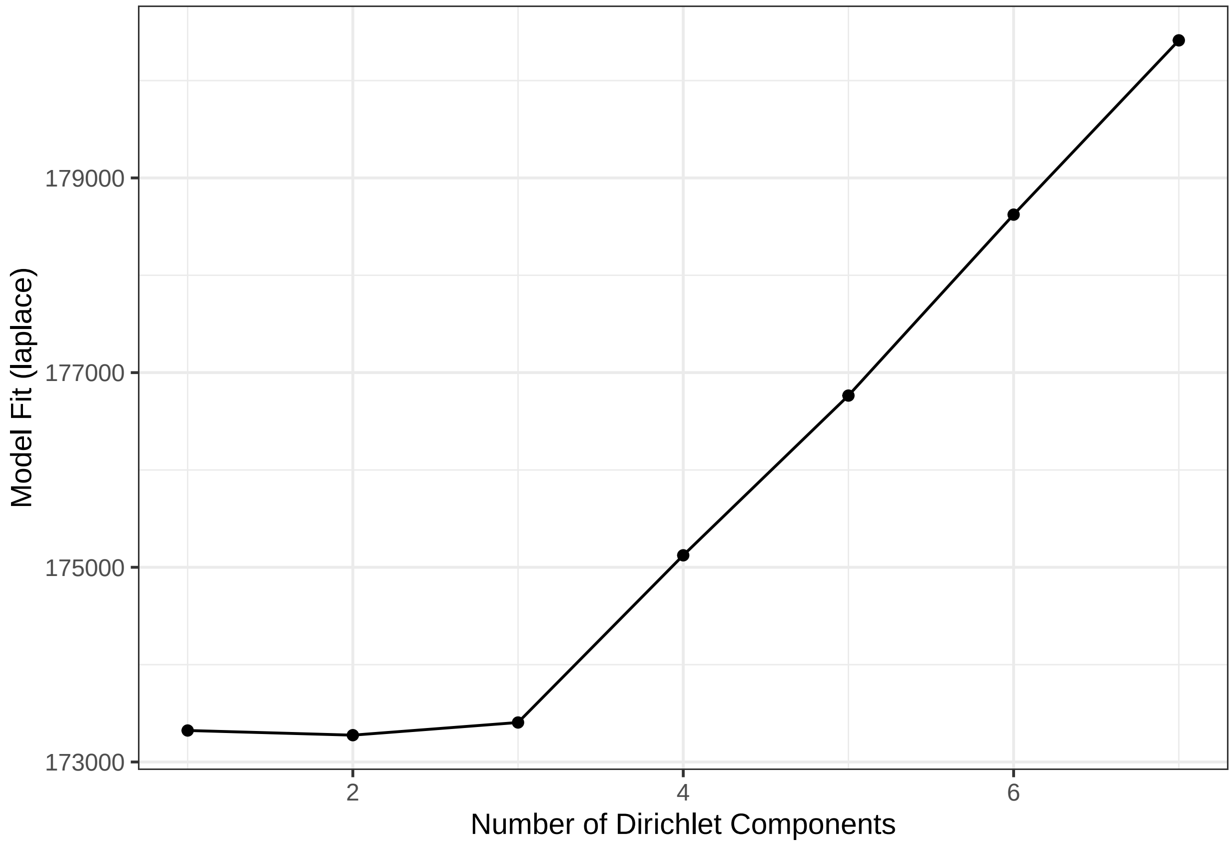
```
## class: TreeSummarizedExperiment
## dim: 1536 120
## metadata(1): DMN
## assays(1): counts
## rownames(1536): 2245974182 2245974034 ... 2245971310 224597986
## rowData names(6): Domain Phylum ... Family Genus
## colnames(120): 2_23 2_24 ... 14_35 14_36
## colData names(27): LibraryNumber Sample_Unique ... Metagenomics Stables
## reducedDimNames(0):
## mainExpName: NULL
## altExpNames(0):
## rowLinks: a LinkDataFrame (1536 rows)
## rowTree: 1 phylo tree(s) (1536 leaves)
## colLinks: NULL
## colTree: NULL
```

```
getDMN(tse_dmn)
```

```
## [[1]]
## class: DMN
```

```
## k: 1
## samples x taxa: 120 x 1536
## Laplace: 173323.4 BIC: 177378.4 AIC: 175237.6
##
## [[2]]
## class: DMN
## k: 2
## samples x taxa: 120 x 1536
## Laplace: 173275.5 BIC: 183190 AIC: 178907.1
##
## [[3]]
## class: DMN
## k: 3
## samples x taxa: 120 x 1536
## Laplace: 173405.6 BIC: 189443.5 AIC: 183018.3
##
## [[4]]
## class: DMN
## k: 4
## samples x taxa: 120 x 1536
## Laplace: 175123.3 BIC: 197172 AIC: 188604.7
##
## [[5]]
## class: DMN
## k: 5
## samples x taxa: 120 x 1536
## Laplace: 176764.2 BIC: 204755.2 AIC: 194045.7
##
## [[6]]
## class: DMN
## k: 6
## samples x taxa: 120 x 1536
## Laplace: 178623.1 BIC: 212663.4 AIC: 199811.7
##
## [[7]]
## class: DMN
## k: 7
## samples x taxa: 120 x 1536
## Laplace: 180413.4 BIC: 220036.1 AIC: 205042.2
```

```
miaViz::plotDMNFit(tse_dmn, type = "laplace")
```




```
getBestDMNFit(tse_dmn, type = "laplace") # 2 again
```

```
## class: DMN
## k: 2
## samples x taxa: 120 x 1536
## Laplace: 173275.5 BIC: 183190 AIC: 178907.1
```

```
# genus level

tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)
tse_genus <- agglomerateByRank(tse, rank = "Genus", agglomerateTree = TRUE)
tse_dmn <- mia::runDMN(tse_genus, name = "DMN", k = 1:7) # calculate most likely number of clusters fro
tse_dmn
```

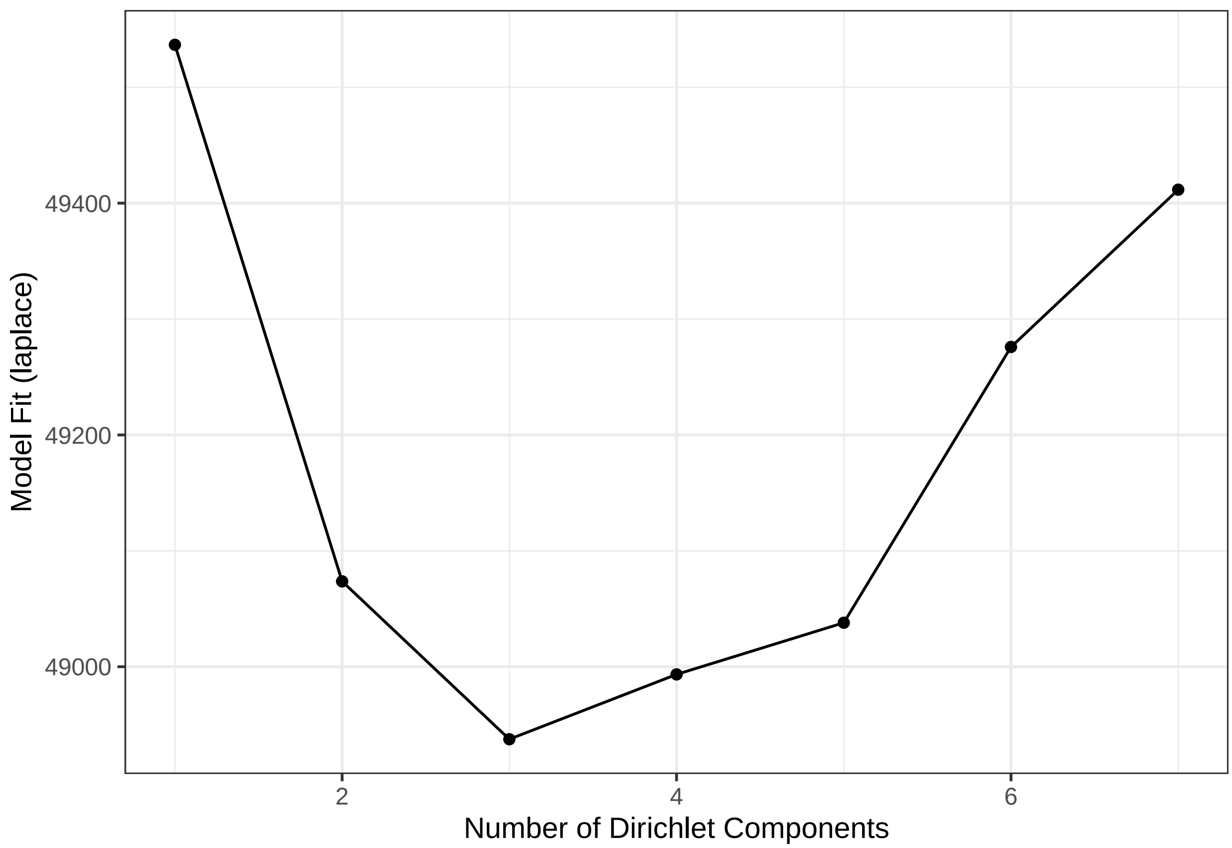
```
## class: TreeSummarizedExperiment
## dim: 119 120
## metadata(2): agglomerated_by_rank DMN
## assays(1): counts
## rownames(119): Genus:g___7_2 Genus:g___5_1 ... Genus:g__Flavonifractor
##   Genus:g__Intestinimonas
## rowData names(6): Domain Phylum ... Family Genus
## colnames(120): 2_23 2_24 ... 14_35 14_36
## colData names(27): LibraryNumber Sample_Unique ... Metagenomics Stables
## reducedDimNames(0):
## mainExpName: NULL
```

```
## altExpNames(0):
## rowLinks: a LinkDataFrame (119 rows)
## rowTree: 1 phylo tree(s) (119 leaves)
## colLinks: NULL
## colTree: NULL
```

```
getDMN(tse_dmn)
```

```
## [[1]]
## class: DMN
## k: 1
## samples x taxa: 120 x 119
## Laplace: 49536.64 BIC: 49751.56 AIC: 49585.7
##
## [[2]]
## class: DMN
## k: 2
## samples x taxa: 120 x 119
## Laplace: 49073.65 BIC: 49634.91 AIC: 49301.81
##
## [[3]]
## class: DMN
## k: 3
## samples x taxa: 120 x 119
## Laplace: 48937.44 BIC: 49800.88 AIC: 49300.53
##
## [[4]]
## class: DMN
## k: 4
## samples x taxa: 120 x 119
## Laplace: 48993.38 BIC: 50167.48 AIC: 49499.88
##
## [[5]]
## class: DMN
## k: 5
## samples x taxa: 120 x 119
## Laplace: 49037.94 BIC: 50571.21 AIC: 49736.36
##
## [[6]]
## class: DMN
## k: 6
## samples x taxa: 120 x 119
## Laplace: 49275.92 BIC: 51124.69 AIC: 50122.58
##
## [[7]]
## class: DMN
## k: 7
## samples x taxa: 120 x 119
## Laplace: 49411.63 BIC: 51635.61 AIC: 50466.26
```

```
miaViz::plotDMNFit(tse_dmn, type = "laplace")
```




```
getBestDMNFit(tse_dmn, type = "laplace") # Gives 3! as best fit for genus level data
```

```
## class: DMN
## k: 3
## samples x taxa: 120 x 119
## Laplace: 48937.44 BIC: 49800.88 AIC: 49300.53
```

```
# phylum level

tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)
tse_phylum <- agglomerateByRank(tse, rank = "Phylum", agglomerateTree = TRUE)
tse_dmn <- mia::runDMN(tse_phylum, name = "DMN", k = 1:7) # calculate most likely number of clusters fr
tse_dmn
```

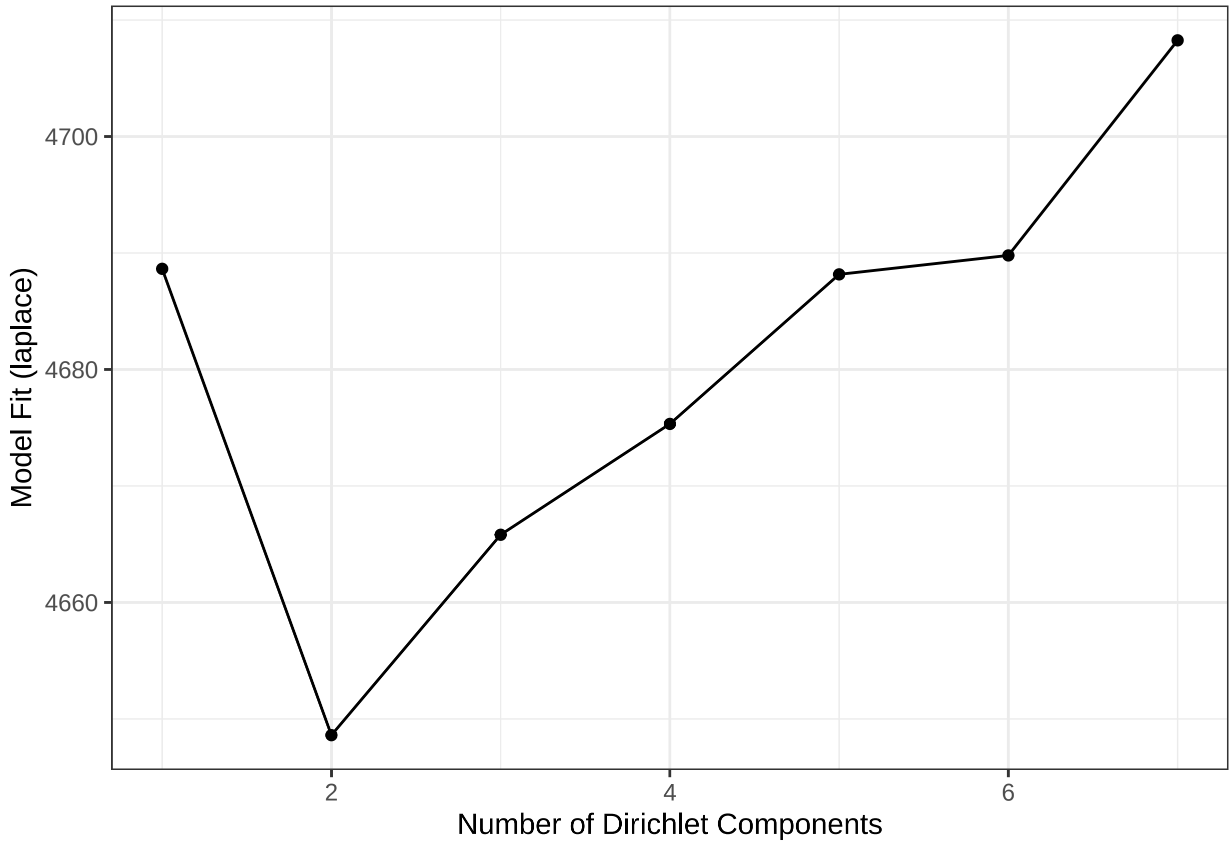
```
## class: TreeSummarizedExperiment
## dim: 7 120
## metadata(2): agglomerated_by_rank DMN
## assays(1): counts
## rownames(7): Phylum:p__Tenericutes Phylum:p__Firmicutes ...
##   Phylum:p__Verrucomicrobia Phylum:p__Cyanobacteria
## rowData names(6): Domain Phylum ... Family Genus
## colnames(120): 2_23 2_24 ... 14_35 14_36
## colData names(27): LibraryNumber Sample_Unique ... Metagenomics Stables
## reducedDimNames(0):
## mainExpName: NULL
```

```
## altExpNames(0):
## rowLinks: a LinkDataFrame (7 rows)
## rowTree: 1 phylo tree(s) (7 leaves)
## colLinks: NULL
## colTree: NULL
```

```
getDMN(tse_dmn)
```

```
## [[1]]
## class: DMN
## k: 1
## samples x taxa: 120 x 7
## Laplace: 4688.641 BIC: 4697.146 AIC: 4687.39
##
## [[2]]
## class: DMN
## k: 2
## samples x taxa: 120 x 7
## Laplace: 4648.607 BIC: 4667.756 AIC: 4646.85
##
## [[3]]
## class: DMN
## k: 3
## samples x taxa: 120 x 7
## Laplace: 4665.811 BIC: 4689.917 AIC: 4657.861
##
## [[4]]
## class: DMN
## k: 4
## samples x taxa: 120 x 7
## Laplace: 4675.328 BIC: 4705.498 AIC: 4662.292
##
## [[5]]
## class: DMN
## k: 5
## samples x taxa: 120 x 7
## Laplace: 4688.166 BIC: 4721.189 AIC: 4666.833
##
## [[6]]
## class: DMN
## k: 6
## samples x taxa: 120 x 7
## Laplace: 4689.791 BIC: 4746.113 AIC: 4680.607
##
## [[7]]
## class: DMN
## k: 7
## samples x taxa: 120 x 7
## Laplace: 4708.256 BIC: 4768.619 AIC: 4691.963
```

```
miaViz::plotDMNFit(tse_dmn, type = "laplace")
```

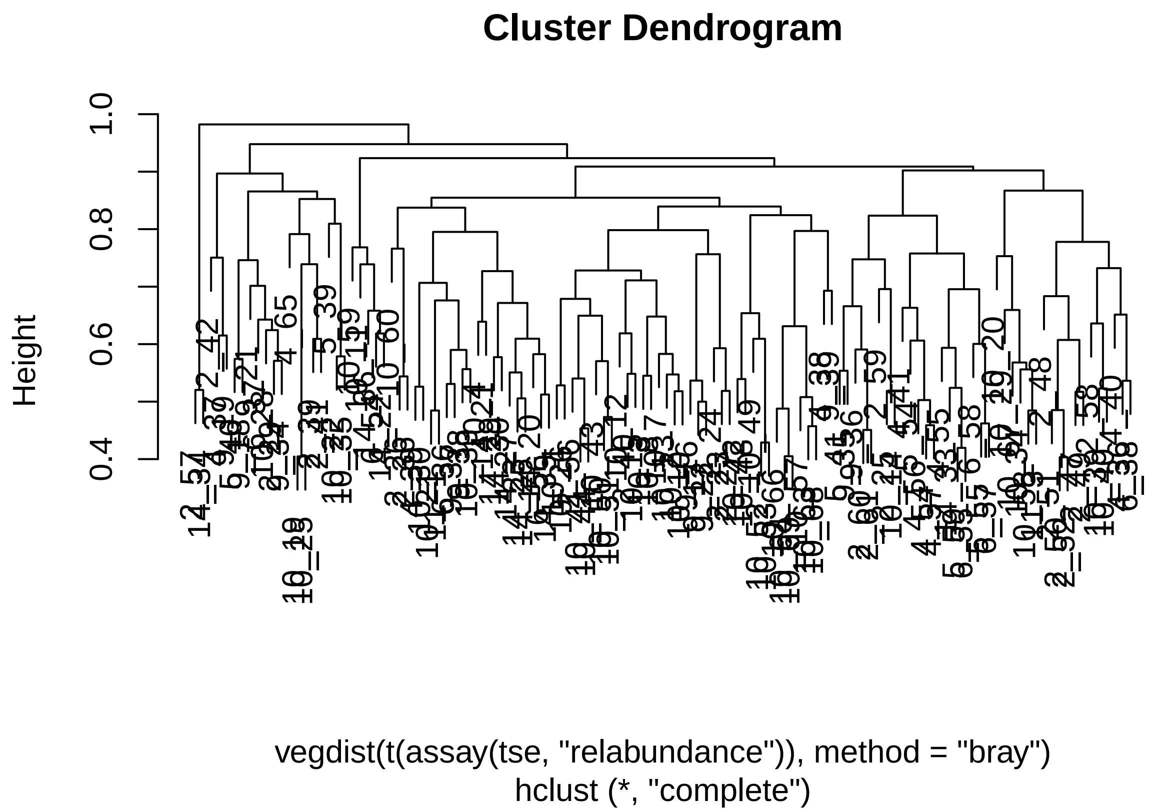



```
getBestDMNFit(tse_dmn, type = "laplace") # Gives 2 as best fit for phylum level data
```

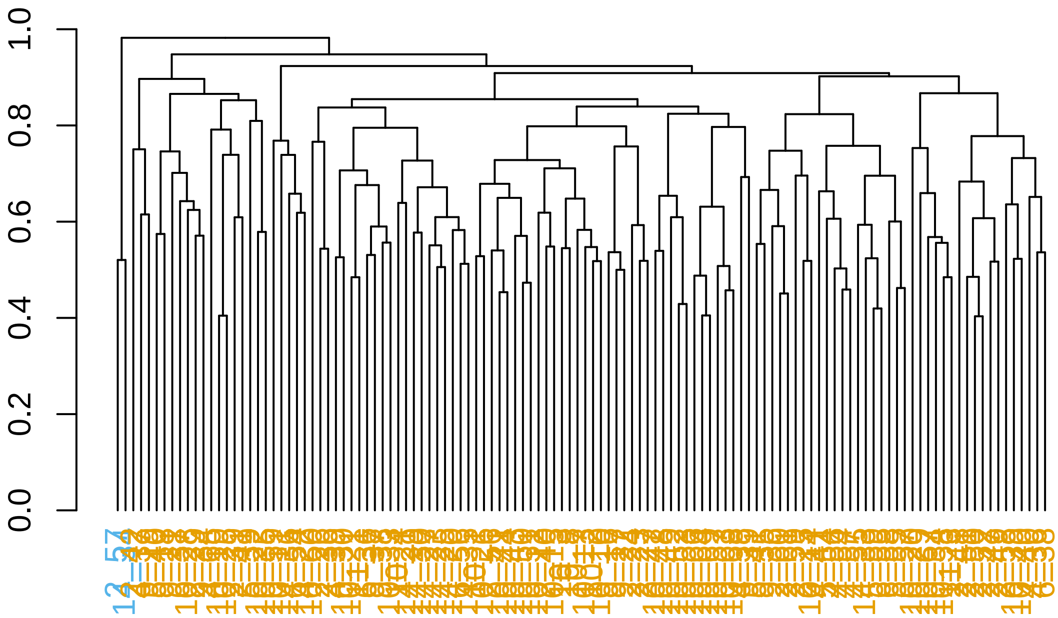
```
## class: DMN
## k: 2
## samples x taxa: 120 x 7
## Laplace: 4648.607 BIC: 4667.756 AIC: 4646.85
```

Hierarchal clustering BC on ASV level

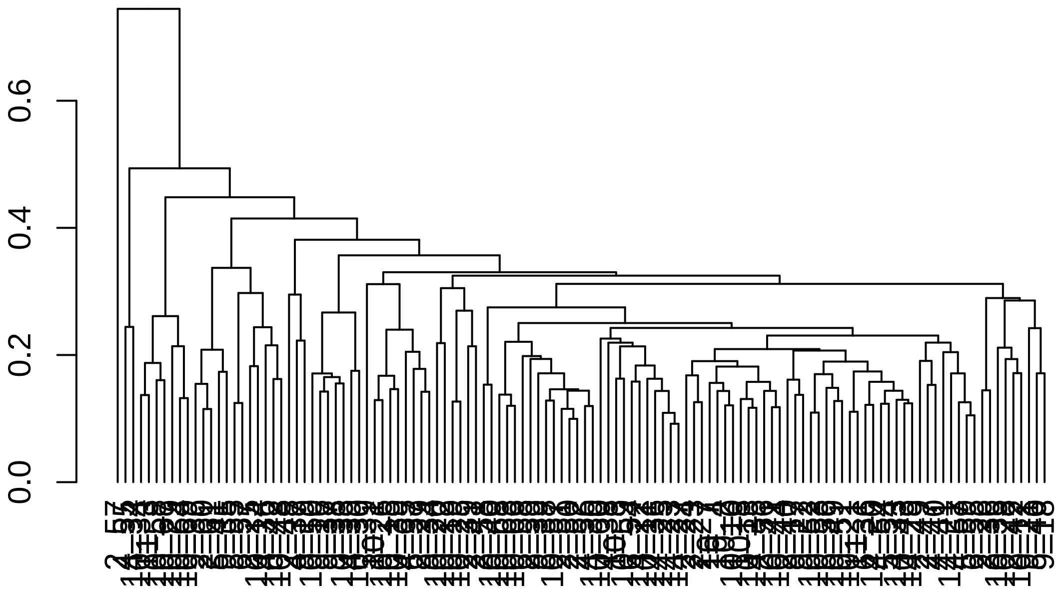
```
tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)
tse <- transformCounts(tse, method = "relabundance")
tse <- runMDS(tse,
              assay.type = "relabundance",
              FUN = vegan::vegdist,
              method = "bray")

hc_bray <- hclust(vegdist(t(assay(tse, "relabundance")), method = "bray"), method = "complete")
plot(hc_bray)
```



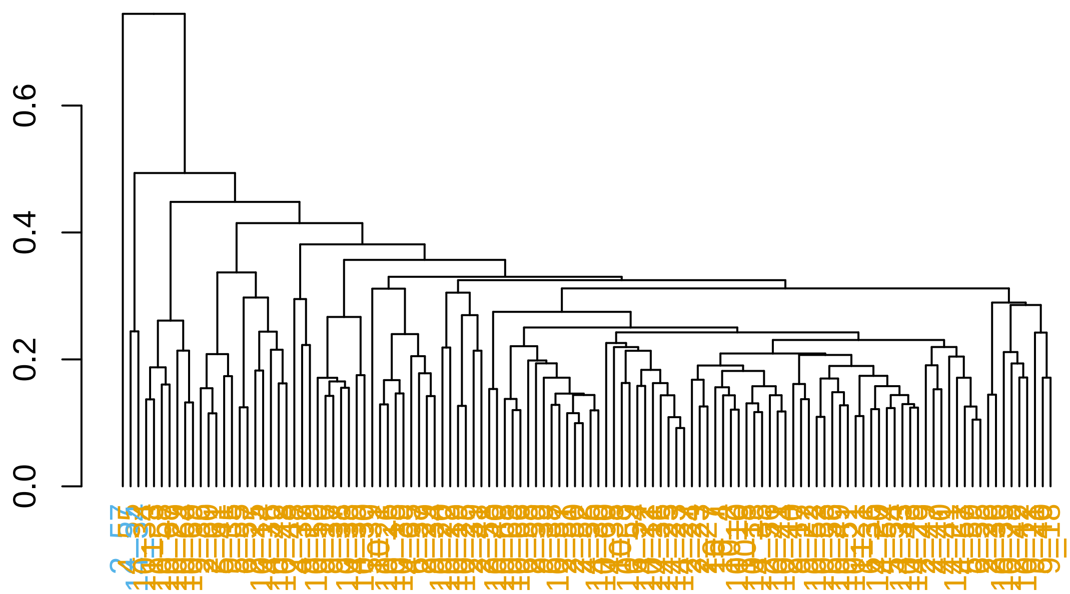

```r
hcd = as.dendrogram(hc_bray)

cbPalette <- c("#999999", "#E69F00", "#56B4E9", "#009E73", "#F0E442",
               "#0072B2", "#D55E00", "#CC79A7")

colorCode <- c(Control=cbPalette[2], CRC = cbPalette[3])

grouping = cutree(hc_bray, k = 2) # most methods gave 2 clusters, based on cuttree

labels_colors(hcd) <- colorCode[grouping][order.dendrogram(hcd)]
plot(hcd)
```



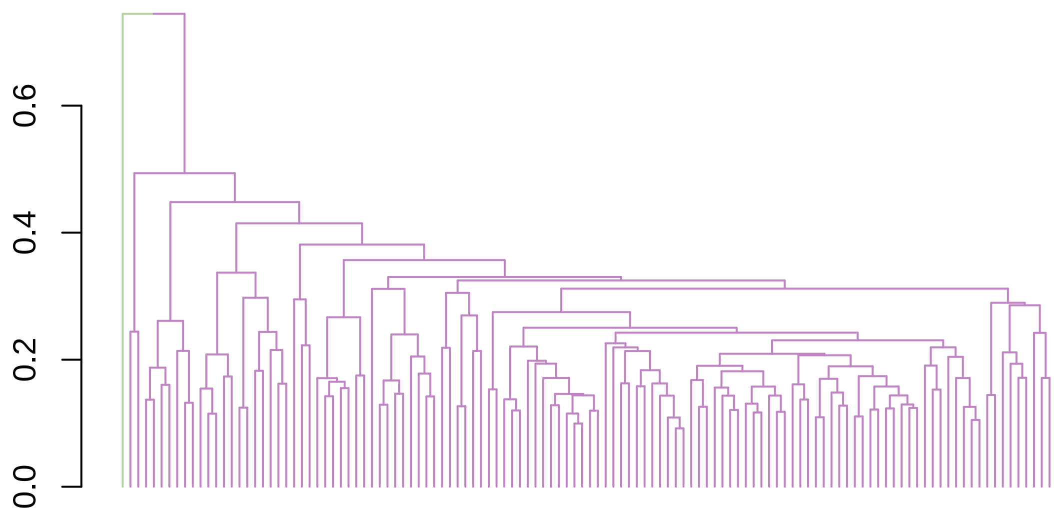

```
hclust.out <- clusterRows(assay, HclustParam(method = "complete"), full = TRUE) # cutting based on comp
colData(tse)$clusters <- hclust.out$clusters
dendro <- as.dendrogram(hclust.out$objects$hclust)
plot(dendro)
```




```
labels_colors(dendro) <- colorCode[grouping][order.dendrogram(dendro)]
plot(dendro)
```



```
col_val_map <- randomcoloR::distinctColorPalette("2") %>%
  as.list() %>%
  setNames(paste0("clust_", seq("2")))

dend <- color_branches(dendro, k = 2, col = unlist(col_val_map))
labels(dend) <- NULL
plot(dend) # based on all three visualisations, only a few samples are clustered distinctly, based on s
```



PAM clustering

```
tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)

tse <- transformCounts(tse, method = "relabundance")

pam.out <- clusterCells(tse,
                        assay.type = "relabundance",
                        BLUSPARAM = PamParam(centers = 2))

pam.out
```

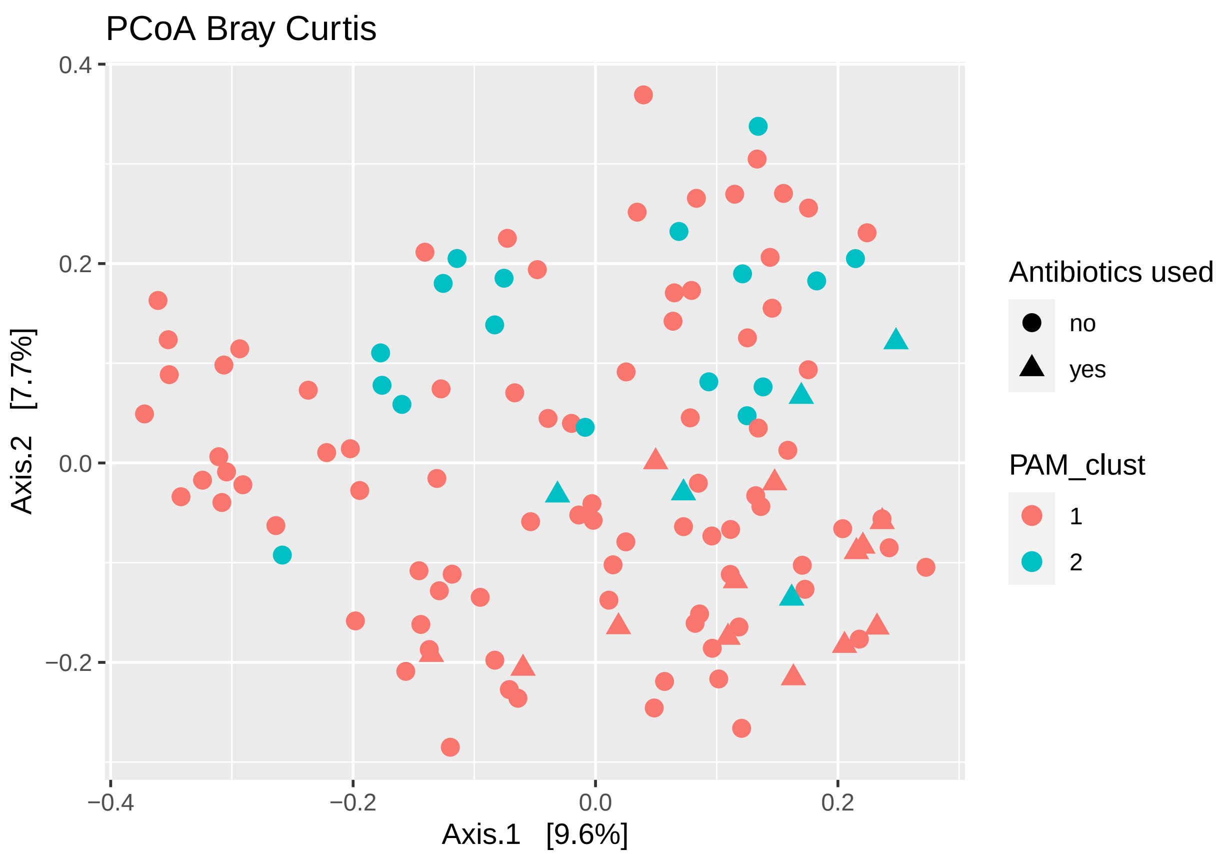
```
##  2_23  2_24  2_25  2_26  2_27  2_29  2_36  2_39  2_40  2_41  2_42  2_47  2_48
##     1     1     2     1     1     1     1     1     1     1     1     1     1
##  2_49  2_50  2_51  2_52  2_56  2_57  2_58  2_59  2_60  2_61  4_36  4_37  4_38
##     1     1     1     1     1     1     1     2     2     2     2     1     1
##  4_39  4_40  4_41  4_54  4_55  4_56  4_57  4_65  5_39  5_40  5_41  5_54  5_55
##     1     1     1     1     2     1     1     1     1     1     2     1     1
##  5_59  6_36  6_37  6_38  6_54  6_55  6_56  6_57  6_58  9_16  9_17  9_18  9_19
##     1     1     1     1     1     1     1     1     1     1     1     1     1
##  9_21  9_22  9_34  9_35  9_36  9_37  9_38  9_39  10_1  10_2  10_3  10_4  10_7
##     1     1     1     2     2     1     1     1     1     1     1     1     1
##  10_8 10_10 10_11 10_12 10_13 10_14 10_15 10_19 10_20 10_21 10_22 10_25 10_26
##     1     1     1     1     1     2     1     1     2     1     1     1     1
## 10_28 10_29 10_30 10_33 10_34 10_35 10_39 10_40 10_41 10_42 10_43 10_44 10_48
##     1     2     1     1     2     1     1     1     1     1     1     1     1
```

```
## 10_49 10_50 10_51 10_52 10_53 10_57 10_58 10_59 10_60 10_63 10_64 10_66 10_67
##     1     1     1     1     1     2     2     1     1     2     2     2     2
## 10_68 10_69  11_1  11_3 14_20 14_21 14_22 14_23 14_25 14_27 14_29 14_30 14_33
##     2     2     1     2     1     1     1     1     1     1     1     1     1
## 14_34 14_35 14_36
##     1     1     1
## Levels: 1 2
```

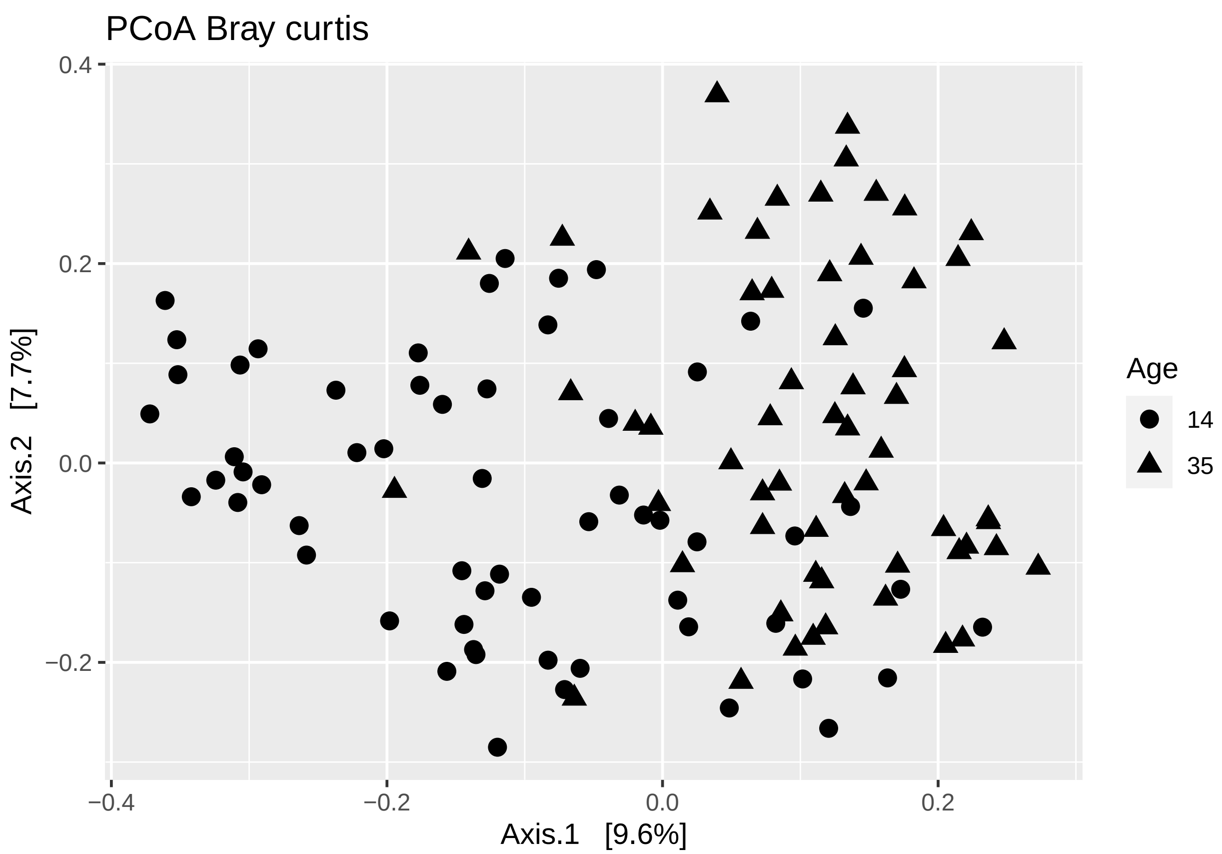
```r
n_iterations <- 1000
previous_cluster_assignment <- NULL
cluster_assignments <- list()

# loop that runs PAM clusterings X times and stores the results in a list, additionally checks if any c
for (i in 1:n_iterations) {
  result <- clusterCells(tse, assay.type = "relabundance", BLUSPARAM = PamParam(centers = 2))
  cluster_assignments[[i]] <- result

  # Check if cluster assignments have changed
  if (!is.null(previous_cluster_assignment)) {
    samples_changed <- which(result != previous_cluster_assignment)
    if (length(samples_changed) > 0) {
      cat(sprintf("In iteration %d, the following samples changed clusters: %s\n", i, paste(samples_char
    }
  }
  previous_cluster_assignment <- result
}

# To see if all of the clusters are the same or not
if (all(sapply(cluster_assignments, identical, cluster_assignments[[1]]))) {
  cat("All cluster assignments are the same across iterations.\n")
} else {
  cat("Cluster assignments vary across iterations.\n")
}
```

```
## All cluster assignments are the same across iterations.
```

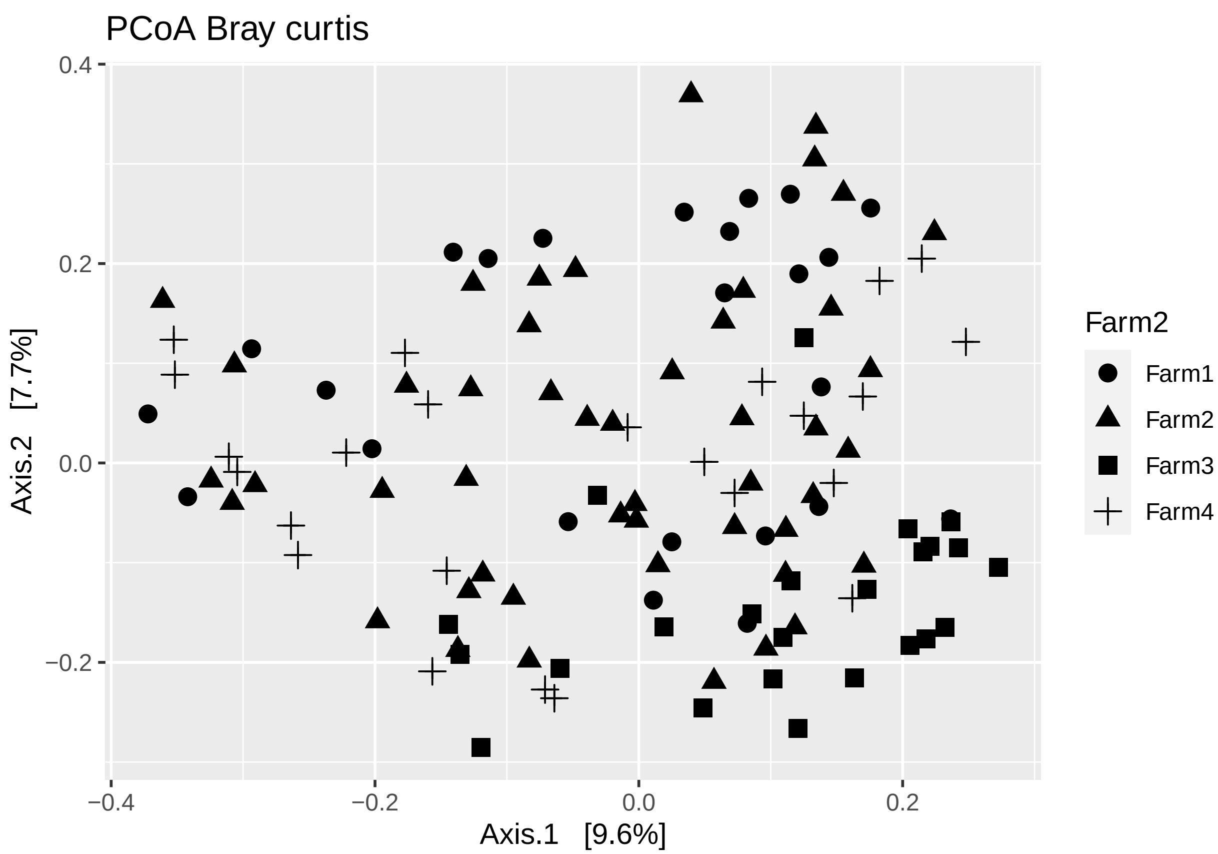
```r
# There are no differences in clusters when run 1000 times

# save to metadata and make original PCoA plot
subset16S@sam_data$PAM_clust = pam.out
sample_data(subset16S)$PAM_clust = as.factor(sample_data(subset16S)$PAM_clust)
pcoa_bc = ordinate(subset16S, "PCoA", "bray")

plot_pcoa_ordination(subset16S, pcoa_bc, "PAM_clust", "PCoA Bray Curtis")
```




```
#plot_pcoa_ordination(subset16S, pcoa_bc, "Cluster", "PCoA Bray Curtis")

# change shape to different variables, age
plot_ordination(subset16S, pcoa_bc, color = "PAM", shape = "Age") +
  geom_point(size = 3)  + labs(title = "PCoA Bray curtis", color = "AMR_class_primary")
```

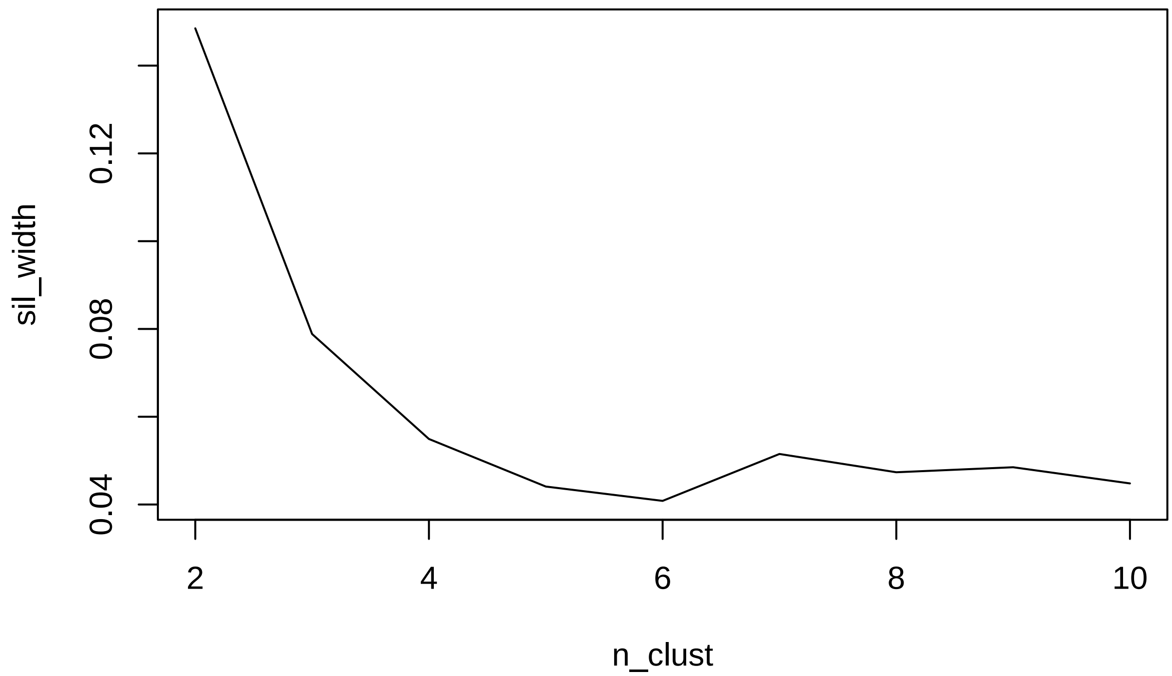



```r
# change shape to different variables, farm
plot_ordination(subset16S, pcoa_bc, color = "PAM", shape = "Farm2") +
  geom_point(size = 3)  + labs(title = "PCoA Bray curtis", color = "AMR_class_primary")
```

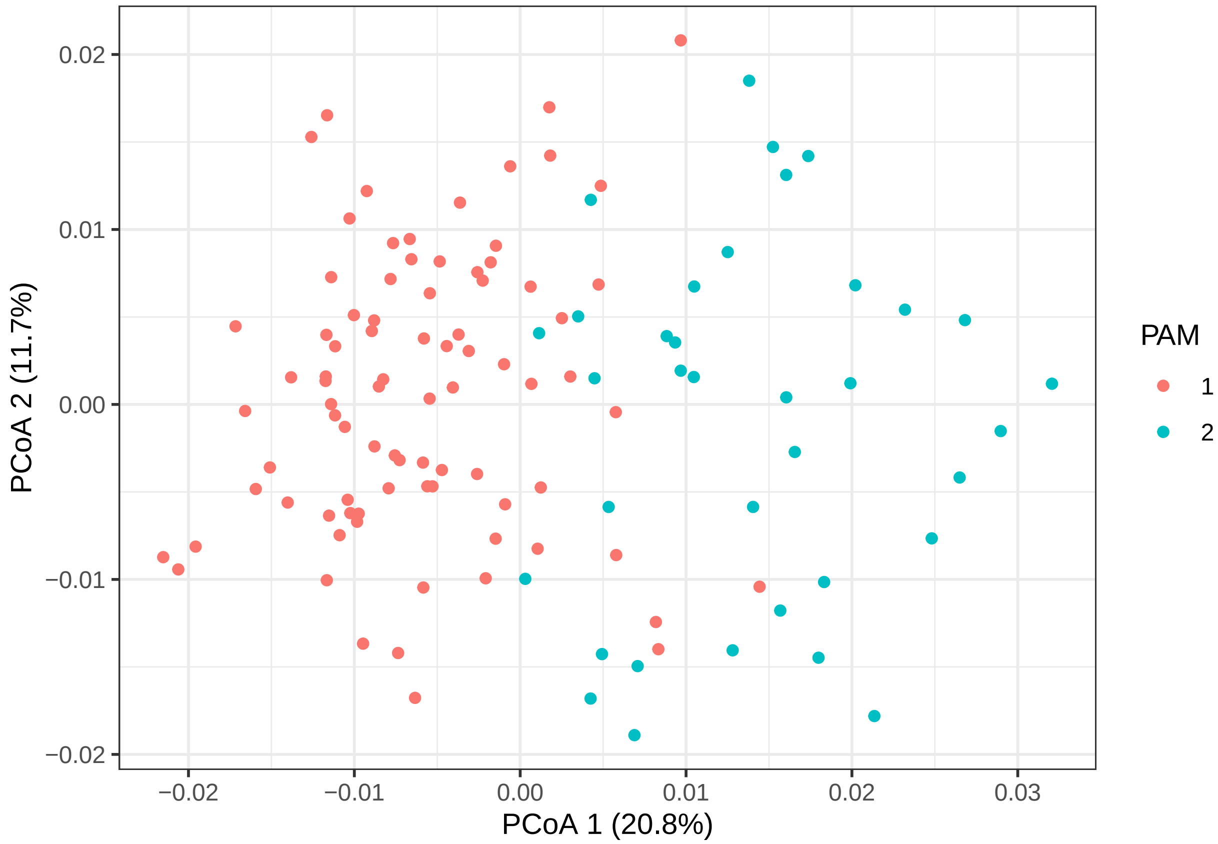


Create PAM UF PCoA - from 2 to 10 clusters

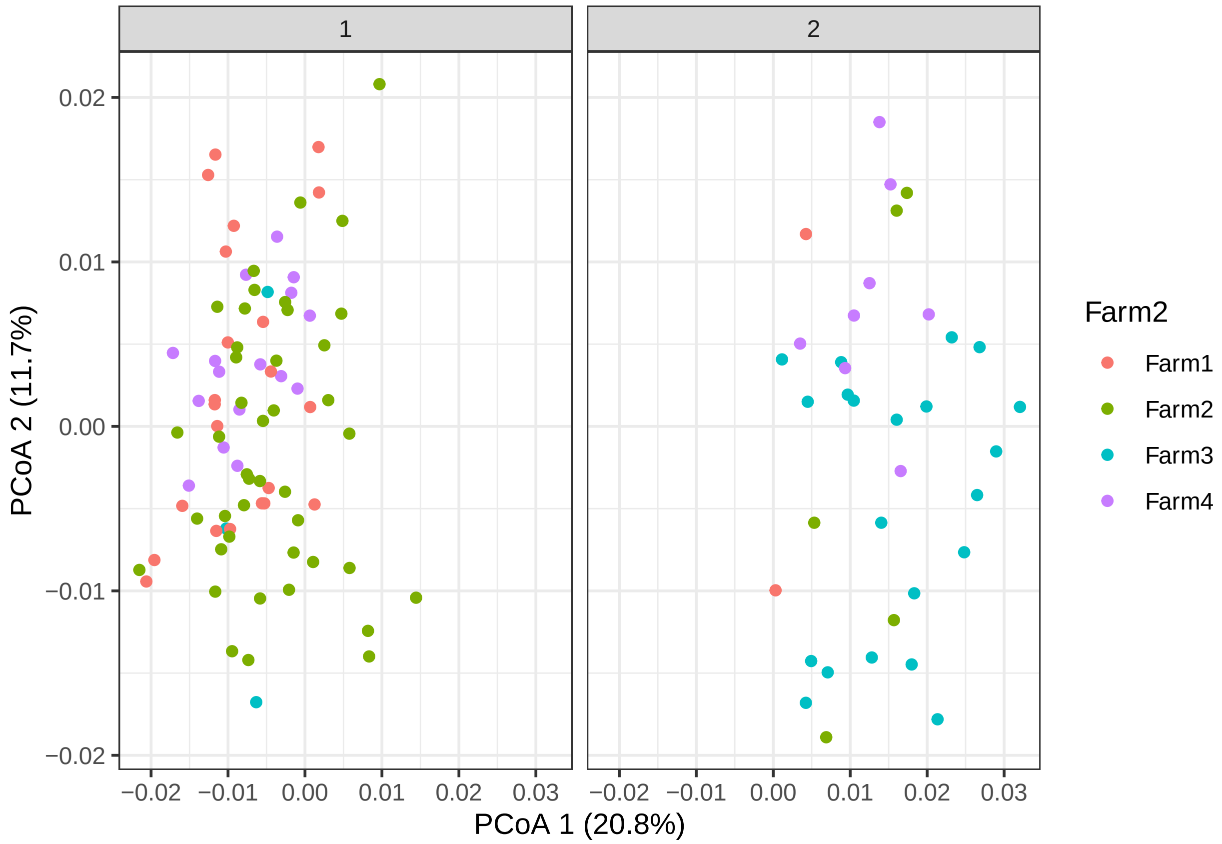
```
phy_rel <- transform_sample_counts(subset16S, function(x) log10(x+1/sum(x+1)))
UF <- UniFrac(phy_rel, weighted = TRUE)
n_clust <- 2:10
pam_list <- lapply(n_clust, function(x) pam(UF, k = x))

sil_width <- lapply(pam_list, function(x) mean(x$silinfo$widths[, "sil_width"]))
plot(n_clust, sil_width, type="l")
```



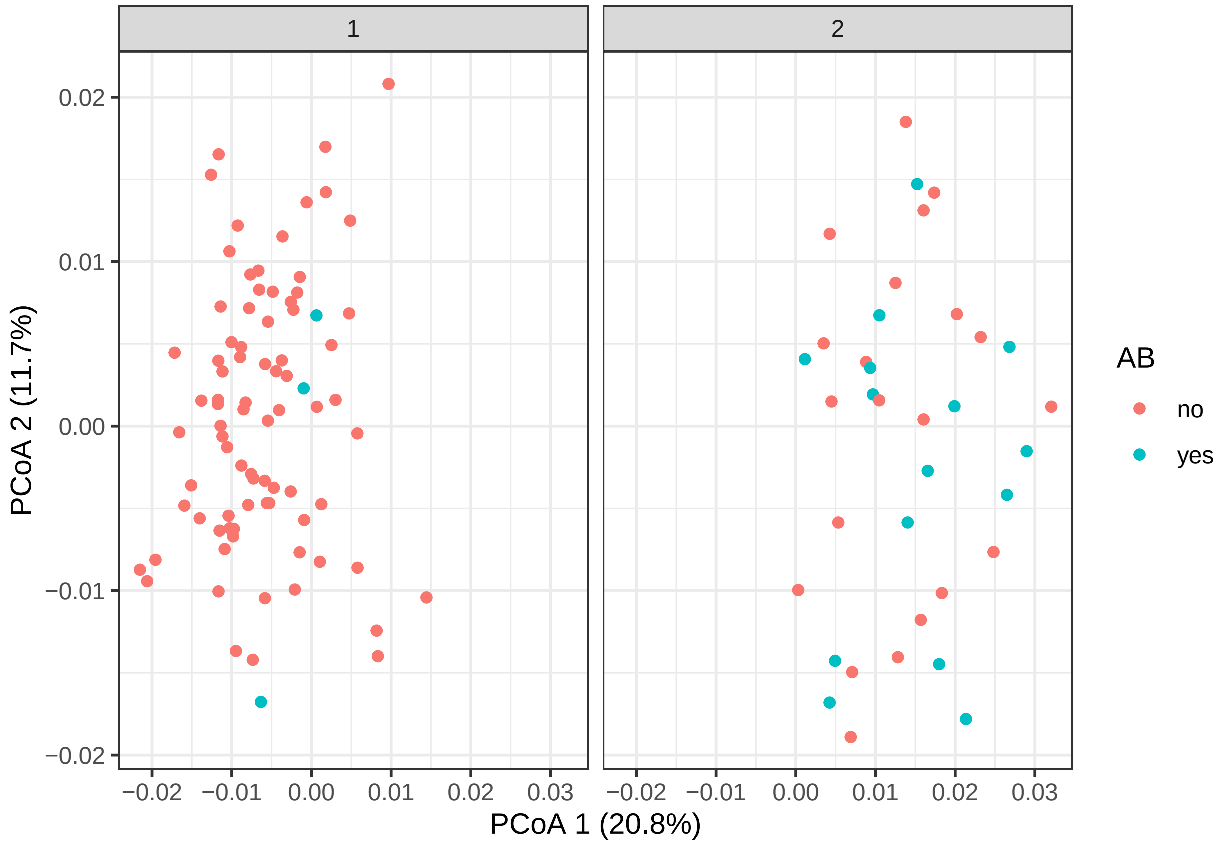

```
pcoa_data <- cmdscale(UF, eig = TRUE)
pcoa_df <- data.frame(PC1 = c(pcoa_data$points[,1]),
                      PC2 = c(pcoa_data$points[,2]),
                      Sample = rownames(pcoa_data$points))

# Add sample data
Samp <- data.frame(sample_data(subset16S))
Samp$Sample <- sample_names(subset16S)

pcoa_df <- merge(pcoa_df, Samp, by = "Sample")

# Add cluster information
clusters <- factor(pam_list[[which.max(sil_width)]]$clustering)
pcoa_df <- merge(pcoa_df, clusters, by.x = "Sample", by.y = "row.names")
colnames(pcoa_df)[ncol(pcoa_df)] <- "PAM"

# Variance explained
ve <- pcoa_data$eig/sum(pcoa_data$eig)

# Plot
ggplot(pcoa_df, aes(x = PC1, y = PC2, color = PAM)) +
  theme_bw() +
  geom_point() +
  xlab(paste0("PCoA 1 (",round(ve[1]*100,1),"%)")) +
  ylab(paste0("PCoA 2 (",round(ve[2]*100,1),"%)"))
```



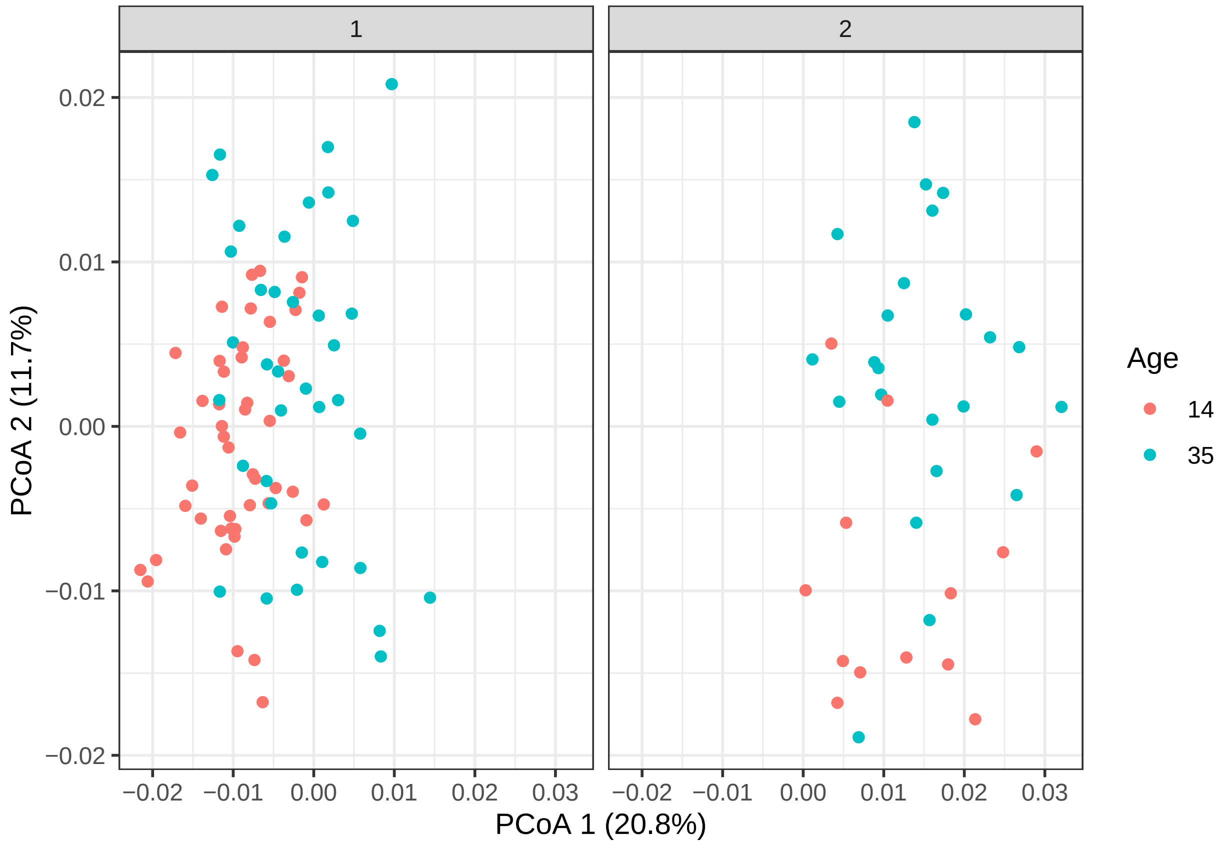

```r
# facet by clusters and colour by farm
ggplot(pcoa_df, aes(x = PC1, y = PC2, color = Farm2)) +
  theme_bw() +
  geom_point() +
  xlab(paste0("PCoA 1 (",round(ve[1]*100,1),"%)")) +
  ylab(paste0("PCoA 2 (",round(ve[2]*100,1),"%)")) +
  facet_wrap(~PAM)
```



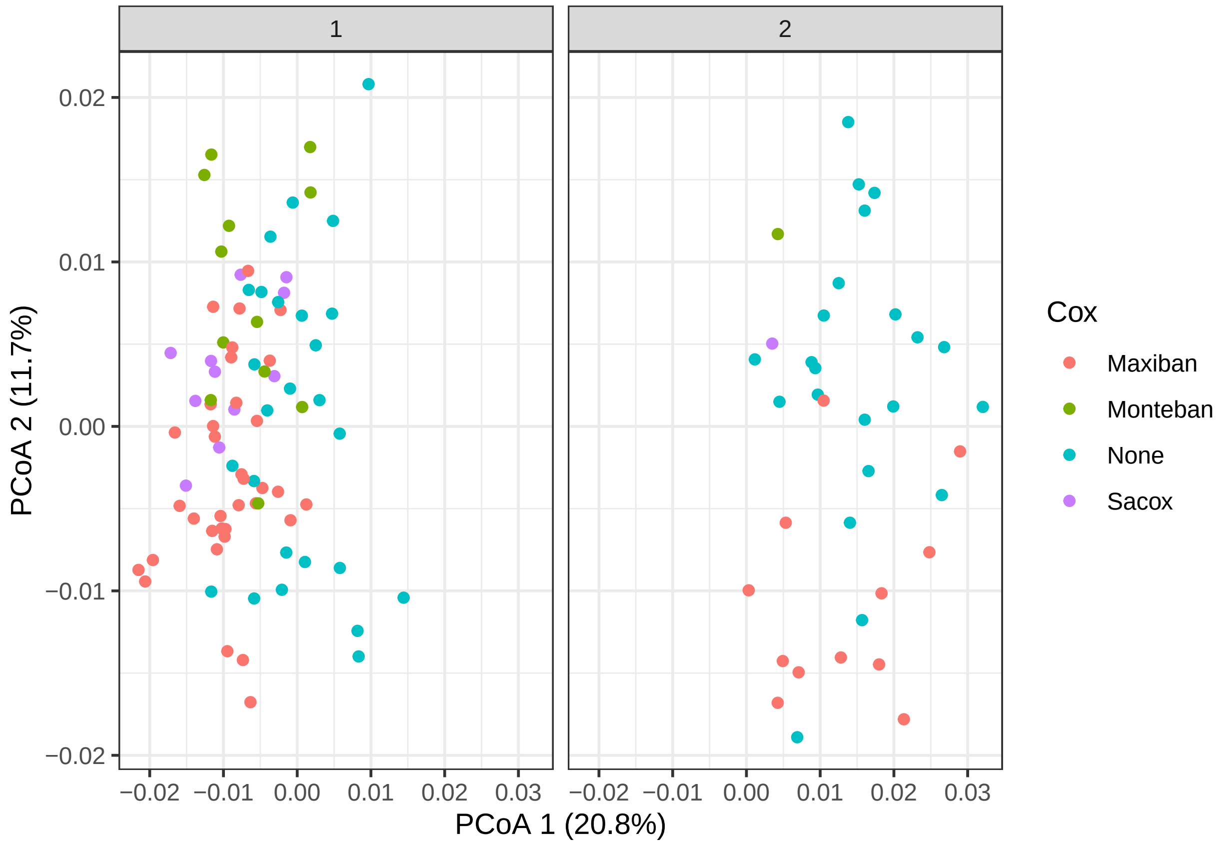

```
# facet by clusters and colour by AB
ggplot(pcoa_df, aes(x = PC1, y = PC2, color = AB)) +
  theme_bw() +
  geom_point() +
  xlab(paste0("PCoA 1 (",round(ve[1]*100,1),"%)")) +
  ylab(paste0("PCoA 2 (",round(ve[2]*100,1),"%)")) +
  facet_wrap(~PAM)
```




```r
# facet by clusters and colour by Age
ggplot(pcoa_df, aes(x = PC1, y = PC2, color = Age)) +
  theme_bw() +
  geom_point() +
  xlab(paste0("PCoA 1 (",round(ve[1]*100,1),"%)")) +
  ylab(paste0("PCoA 2 (",round(ve[2]*100,1),"%)")) +
  facet_wrap(~PAM)
```




```
# facet by clusters and colour by Agent
ggplot(pcoa_df, aes(x = PC1, y = PC2, color = Cox)) +
  theme_bw() +
  geom_point() +
  xlab(paste0("PCoA 1 (",round(ve[1]*100,1),"%)")) +
  ylab(paste0("PCoA 2 (",round(ve[2]*100,1),"%)")) +
  facet_wrap(~PAM)
```



PCoA for Phylum data, BC with DMM, euclidian (can change tax level with tse_dmn)

```
dmn_group <- calculateDMNgroup(tse_dmn,
                               variable = "Age", assay.type = "counts",
                               k = 2, seed = .Machine$integer.max)

dmn_group <- calculateDMNgroup(tse_dmn,
                               variable = "Farm2", assay.type = "counts",
                               k = 2, seed = .Machine$integer.max)
dmn_group <- calculateDMNgroup(tse_dmn,
                               variable = "AB", assay.type = "counts",
                               k = 2, seed = .Machine$integer.max)
dmn_group
```

```
## class: DMNGroup
## summary:
##     k samples taxa       NLE   LogDet   Laplace       BIC       AIC
## no  2     102    7 3831.1379 59.71807 3847.2128 3865.8252 3846.1379
## yes 2      18    7  818.2031 47.31140  828.0747  839.8809  833.2031
```

```
DirichletMultinomial::mixturewt(getBestDMNFit(tse_dmn)) # measure weights
```

```
##          pi     theta
## 1 0.628418 31.806259
## 2 0.371582  6.573224
```

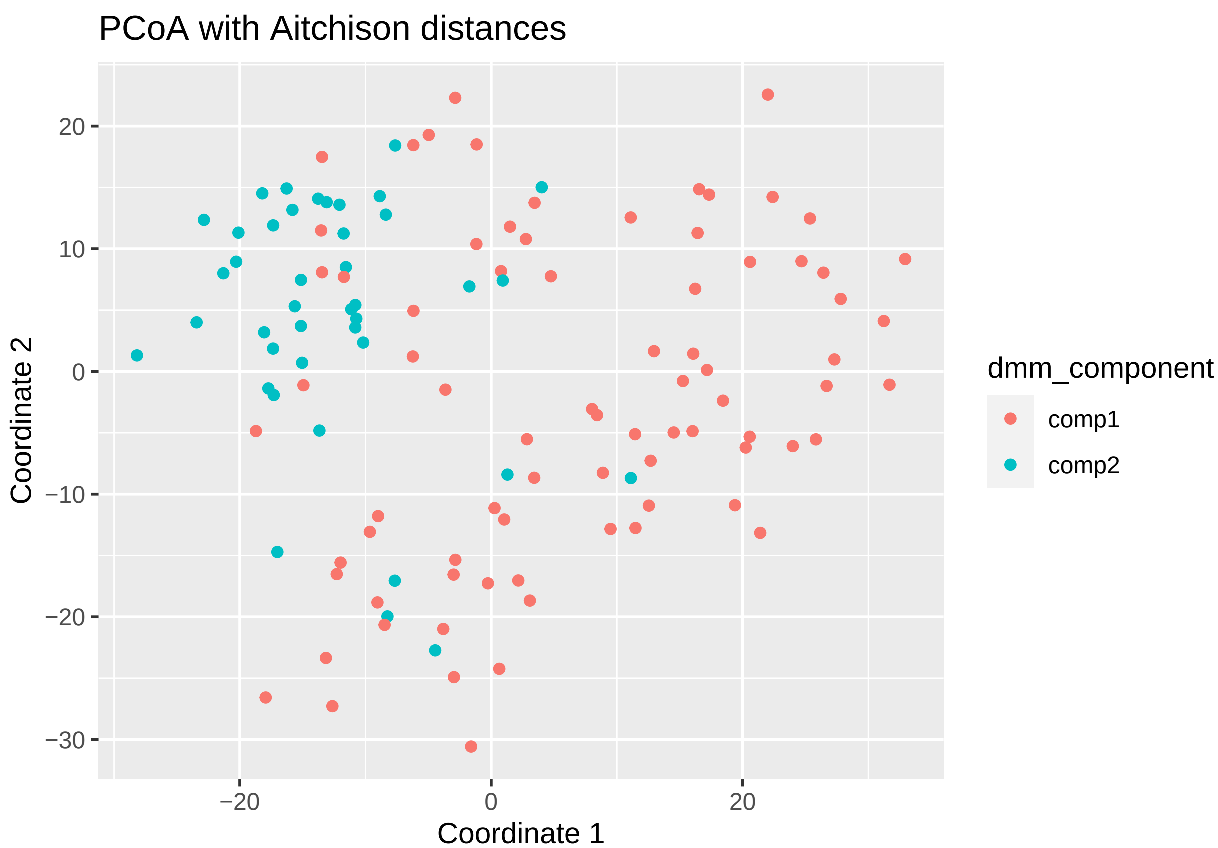
```r
head(DirichletMultinomial::mixture(getBestDMNFit(tse_dmn))) # sample-cluster assignment probablities
```

```
##              [,1]       [,2]
## 2_23 0.9727179084 0.02728209
## 2_24 0.0175821347 0.98241787
## 2_25 0.0010190173 0.99898098
## 2_26 0.0010546064 0.99894539
## 2_27 0.9280199742 0.07198003
## 2_29 0.0008818687 0.99911813
```

```r
head(DirichletMultinomial::fitted(getBestDMNFit(tse_dmn))) # taxa contribution
```

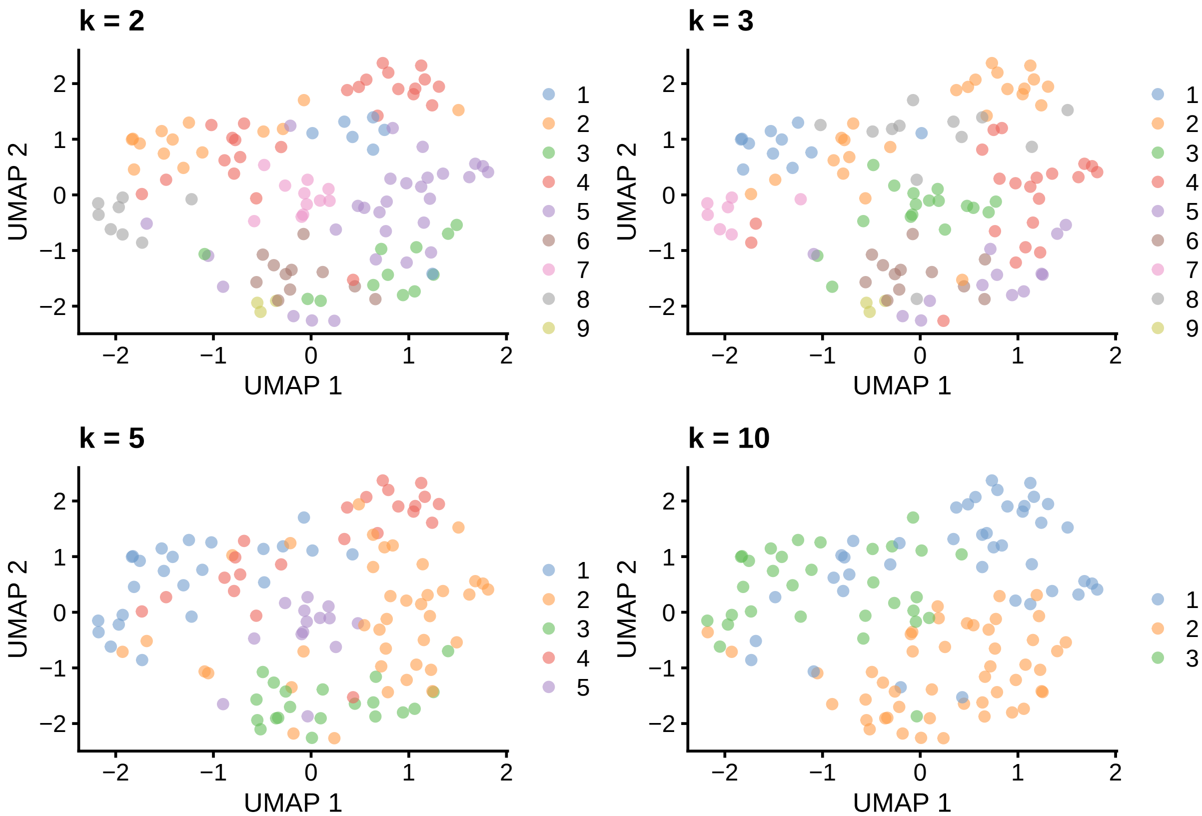
```
##                                  [,1]         [,2]
## Phylum:p__Tenericutes      1.09277350 0.0842149816
## Phylum:p__Firmicutes      28.74250221 5.6267113566
## Phylum:p__Bacteroidetes    0.89459787 0.1209397315
## Phylum:p__Proteobacteria   0.28242718 0.2800613651
## Phylum:p__Actinobacteria   0.71698835 0.4555026874
## Phylum:p__Verrucomicrobia  0.01598885 0.0002660301
```

```r
prob <- DirichletMultinomial::mixture(getBestDMNFit(tse_dmn))
colnames(prob) <- c("comp1", "comp2")
vec <- colnames(prob)[max.col(prob, ties.method = "first")]
assay(tse, "pseudo") <- assay(tse, "counts") + 1
tse <- transformCounts(tse, assay.type = "pseudo", method = "relabundance")
tse <- transformCounts(tse, "relabundance", method = "clr")
df <- calculateMDS(tse, assay.type = "clr", method = "euclidean")
euclidean_pcoa_df <- data.frame(
  pcoa1 = df[, 1],
  pcoa2 = df[, 2])
euclidean_dmm_pcoa_df <- cbind(euclidean_pcoa_df,
                               dmm_component = vec)

ggplot(data = euclidean_dmm_pcoa_df, aes(x = pcoa1, y = pcoa2, color = dmm_component)) +
  geom_point() +
  labs(x = "Coordinate 1",
    y = "Coordinate 2",
    title = "PCoA with Aitchison distances")
```

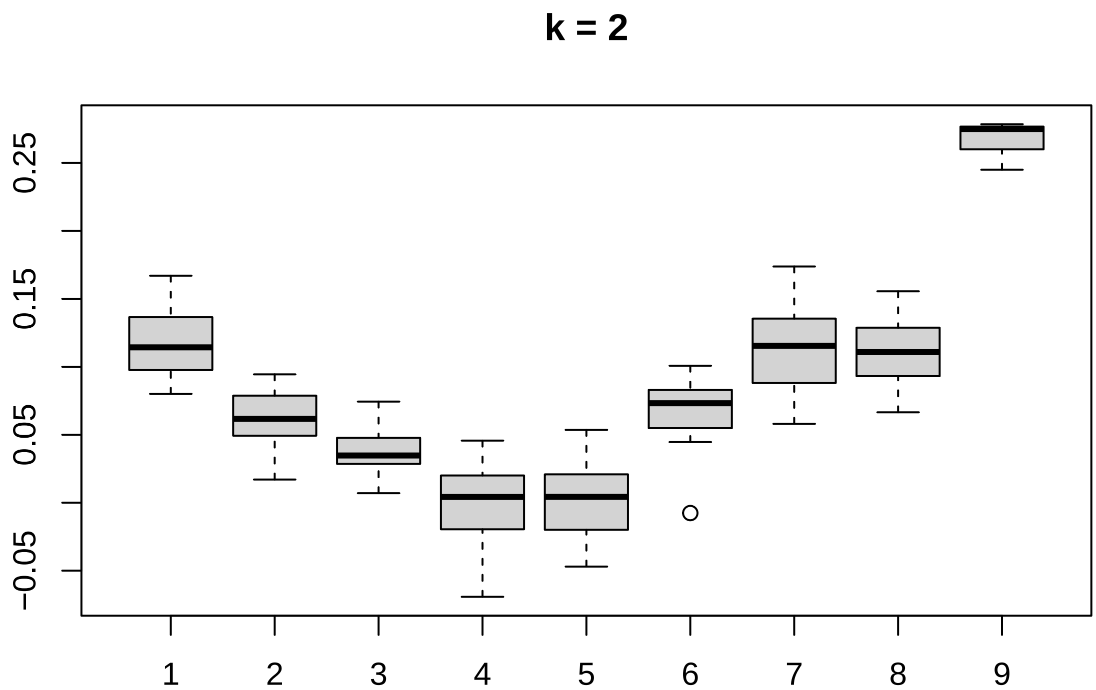


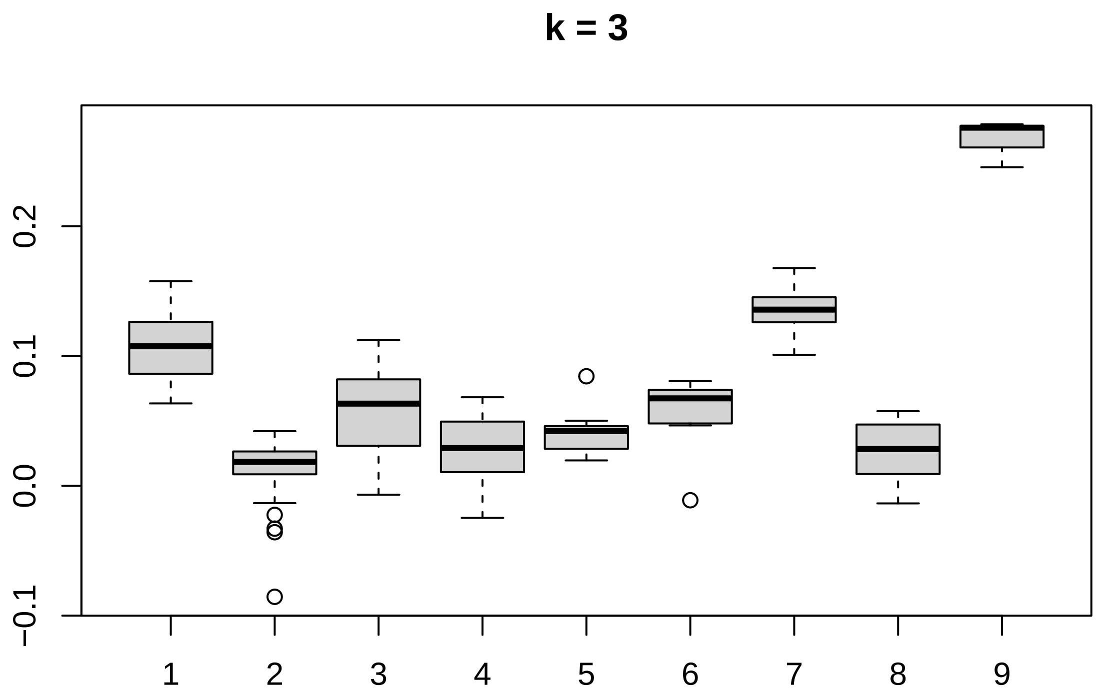
UMAP with different ks

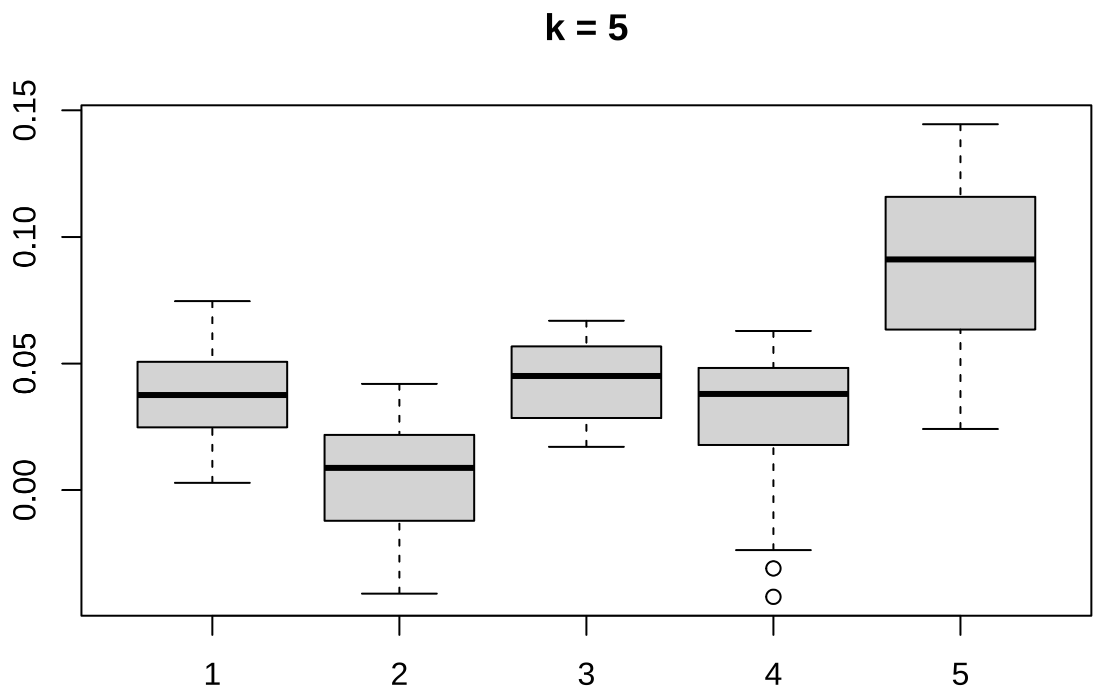
```
tse = makeTreeSummarizedExperimentFromPhyloseq(subset16S)
tse <- transformCounts(tse, method = "rclr")
tse <- runUMAP(tse, name = "UMAP", assay.type = "rclr")
k <- c(2, 3, 5, 10)
ClustAndPlot <- function(x) {
  # Creating the graph and running the short random walks algorithm
  graph_clusters <- clusterRows(t(assays(tse)$rclr), NNGraphParam(k = x))

  # Results of the clustering as a color for each sample
  plotUMAP(tse, colour_by = I(graph_clusters)) +
    labs(title = paste0("k = ", x))
}
plots <- lapply(k, ClustAndPlot)
(plots[[1]] + plots[[2]]) / (plots[[3]] + plots[[4]])
```

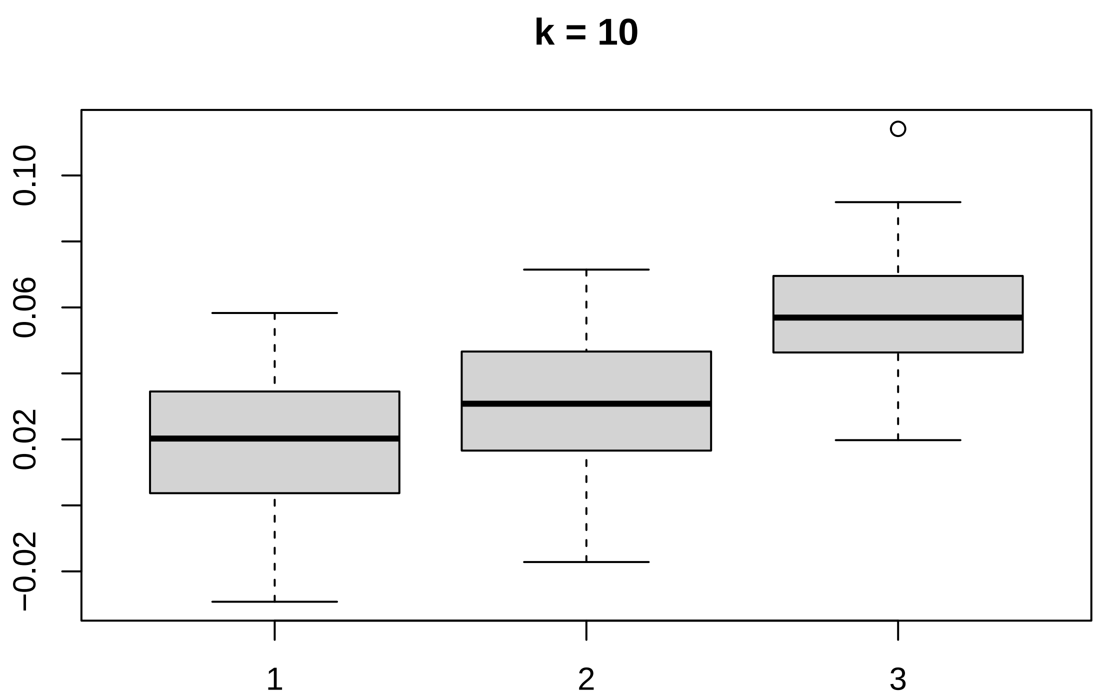



```r
# boxplots
ClustDiagPlot <- function(x) {
  # Getting the clustering results
  graph_clusters <- clusterRows(t(assays(tse)$rclr), NNGraphParam(k = x))

  # Computing the diagnostic info
  sil <- approxSilhouette(t(assays(tse)$rclr), graph_clusters)

  # Plotting as a boxlpot to observe cluster separation
  boxplot(split(sil$width, graph_clusters), main = paste0("k = ", x))
}
# Applying the function for different k values
res <- lapply(k, ClustDiagPlot)
```


k = 2
0.25
0.15
0.05
−0.05
1
2
3
4
5
6
7
8
9


k = 3
0.2
0.1
0.0
−0.1
1
2
3
4
5
6
7
8
9


k = 5
0.00
0.05
0.10
0.15
1
2
3
4
5



Metagenomic data

Loading data

```
### Loading a subset of metagenomic data into phyloseq format
subsetMG= import_biom("kraken2_output.biom") # this imports a .biom created by kraken2-biom  containing

# We rewrite the sample names to a format filtering out Firm and firm and the first underscore so that
sample_names(subsetMG) = sapply(regmatches(sample_names(subsetMG), regexpr("_", sample_names(subsetMG))

# Because the names in both metadata sets do not completely overlap, we need to manually edit one of th
sample_names(subsetMG)[68] = "4_65"

# reading in and combining metadata from 16S and metagenomic origins, adding missing underscores
firm_names = read_excel("./Metagenomic/FIRM_MetaNames.xlsx")
firm_names = firm_names[,-2] # Remove wrongful Raw_data_name column, to avoid confusion

meta_data = read.csv("MetaData.csv", header = TRUE, sep = ",")
meta_data_MG = dplyr::right_join(firm_names, meta_data, by="SampleID")

# using Sample_Unique as rownames so we can match the two sets in phyloseq
rownames(meta_data_MG) = meta_data_MG$Sample_Unique

# now we'll also add in microbial load
```

```r
microbial_load = read.table("bacterial_load_kraken2.tab", sep = "\t", header = TRUE)
microbial_load$Sample_Unique = sapply(regmatches(microbial_load$Sample_Unique, regexpr("_",microbial_lo
microbial_load$Sample_Unique[68] = "4_65"
meta_data_MG = dplyr::right_join(meta_data_MG, microbial_load, by="Sample_Unique")

# creating tree and making phyloseq components, adding tree and sample data components to phyloseq
set.seed("878") # setting seed for reproducibility purposes
random_tree = rtree(ntaxa(subsetMG), rooted=TRUE, tip.label=taxa_names(subsetMG))
meta_data_MG = sample_data(meta_data_MG)
rownames(meta_data_MG) = meta_data_MG$Sample_Unique
subsetMG = merge_phyloseq(subsetMG, meta_data_MG, random_tree)
class(subsetMG)
```

```
## [1] "phyloseq"
## attr(,"package")
## [1] "phyloseq"
```

```r
# set Rank names
colnames(tax_table(subsetMG)) = c("Domain", "Phylum", "Class", "Order", "Family", "Genus", "Species")
rank_names(subsetMG)
```

```
## [1] "Domain"  "Phylum"  "Class"   "Order"   "Family"  "Genus"   "Species"
```

```r
### overview data
datatable(tax_table(subsetMG))
```

```r
subsetMG # 7058 taxa
```

```
## phyloseq-class experiment-level object
## otu_table()   OTU Table:         [ 7058 taxa and 120 samples ]
## sample_data() Sample Data:       [ 120 samples by 34 sample variables ]
## tax_table()   Taxonomy Table:    [ 7058 taxa by 7 taxonomic ranks ]
## phy_tree()    Phylogenetic Tree: [ 7058 tips and 7057 internal nodes ]
```

```r
# filter out non bacterial domains (no chloroplast, mitochondrial "taxa" present)
subsetMG <- subset_taxa(subsetMG, Domain!="k__Archaea")
subsetMG <- subset_taxa(subsetMG, Domain!="k__Viruses")
subsetMG <- subset_taxa(subsetMG, Domain!="k__Eukaryota")

subsetMG # 6355 taxa
```

```
## phyloseq-class experiment-level object
## otu_table()   OTU Table:         [ 6355 taxa and 120 samples ]
## sample_data() Sample Data:       [ 120 samples by 34 sample variables ]
## tax_table()   Taxonomy Table:    [ 6355 taxa by 7 taxonomic ranks ]
## phy_tree()    Phylogenetic Tree: [ 6355 tips and 6354 internal nodes ]
```

```r
# Amount of different taxa present.
sort(table(tax_table(subsetMG)[, "Phylum"]))
```

```
##
##                 p__Balneolota                   p__Caldisericota
##                             1                                  1
##              p__Calditrichota  p__Candidatus Bipolaricaulota
##                             1                                  1
##     p__Candidatus Omnitrophota                 p__Chrysiogenota
##                             1                                  1
##       p__Coprothermobacterota                 p__Fibrobacterota
##                             1                                  1
##             p__Lentisphaerota                   p__Nitrospinota
##                             1                                  1
##             p__Armatimonadota                  p__Dictyoglomota
##                             2                                  2
##           p__Kiritimatiellota              p__Thermomicrobiota
##                             2                                  2
##            p__Elusimicrobiota                  p__Rhodothermota
##                             3                                  4
## p__Candidatus Saccharibacteria              p__Deferribacterota
##                             5                                  6
##            p__Gemmatimonadota                     p__Aquificota
##                             6                                  7
##               p__Nitrospirota              p__Bdellovibrionota
##                             7                                  9
##                 p__Chlamydiota                             p__
##                             9                                 10
##               p__Synergistota                  p__Thermotogota
##                            15                                 17
##                 p__Chlorobiota                 p__Chloroflexota
##                            18                                 21
##            p__Acidobacteriota              p__Verrucomicrobiota
##                            28                                 28
##             p__Fusobacteriota                   p__Myxococcota
##                            29                                 37
##               p__Deinococcota                 p__Spirochaetota
##                            44                                 59
##            p__Planctomycetota                p__Mycoplasmatota
##                            65                                 69
##           p__Campylobacterota              p__Cyanobacteriota
##                            76                                118
##     p__Thermodesulfobacteriota                  p__Bacteroidota
##                           122                                414
##                   p__Bacillota               p__Actinomycetota
##                          1240                               1488
##             p__Pseudomonadota
##                          2383
```

```
sort(table(tax_table(subsetMG)[, "Order"]))
```

```
##
##      o__Acanthopleuribacterales                 o__Acidothermales
##                               1                                 1
##           o__Actinopolysporales                    o__Balneolales
##                               1                                 1
##               o__Bryobacterales                  o__Caldilineales
```

```
##                               1                               1
##                 o__Caldisericales                o__Calditrichales
##                               1                               1
##         o__Candidatus Brocadiales  o__Candidatus Izemoplasmatales
##                               1                               1
##  o__Candidatus Saccharimonadales o__Candidatus Sulfidibacteriales
##                               1                               1
##               o__Catenulisporales       o__Chroococcidiopsidales
##                               1                               1
##                 o__Chrysiogenales             o__Chthonomonadales
##                               1                               1
##          o__Coprothermobacterales              o__Desulfarculales
##                               1                               1
##                o__Desulfobaccales             o__Desulfomonilales
##                               1                               1
##                o__Desulfurellales                o__Egibacterales
##                               1                               1
##                    o__Egicoccales             o__Elusimicrobiales
##                               1                               1
##                     o__Euzebyales                   o__Ferrovales
##                               1                               1
##                o__Fibrobacterales             o__Fimbriimonadales
##                               1                               1
##              o__Gloeomargaritales                 o__Haliangiales
##                               1                               1
##              o__Hydrogenophilales       o__Immundisolibacterales
##                               1                               1
##                 o__Kineosporiales           o__Kiritimatiellales
##                               1                               1
##                o__Koleobacterales              o__Kordiimonadales
##                               1                               1
##              o__Ktedonobacterales              o__Lentisphaerales
##                               1                               1
##                 o__Limisphaerales               o__Limnochordales
##                               1                               1
##                o__Magnetococcales             o__Mesoaciditogales
##                               1                               1
##                   o__Nannocystales                 o__Nitrospinales
##                               1                               1
##               o__Phototrophicales             o__Salinisphaerales
##                               1                               1
##                 o__Sneathiellales           o__Sphaerobacterales
##                               1                               1
##                 o__Sporichthyales                 o__Syntrophales
##                               1                               1
##               o__Tepidisphaerales           o__Thermoleophilales
##                               1                               1
##              o__Thermomicrobiales              o__Thermostichales
##                               1                               1
##              o__Thermotomaculales              o__Tichowtungiales
##                               1                               1
##                    o__Trueperales           o__Bacteriovoracales
##                               1                               2
##   o__Candidatus Pelagibacterales           o__Dehalococcoidales
```

```
##                            2                              2
##        o__Desulfurobacteriales              o__Dictyoglomales
##                            2                              2
##              o__Emcibacterales            o__Endomicrobiales
##                            2                              2
##                o__Kangiellales        o__Methylacidiphilales
##                            2                              2
##             o__Parvularculales              o__Pleurocapsales
##                            2                              2
##             o__Puniceicoccales               o__Saprospirales
##                            2                              2
##         o__Syntrophobacterales     o__Thermodesulfovibrionales
##                            2                              2
##              o__Anaerolineales        o__Candidatus Babeliales
##                            3                              3
##  o__Candidatus Nanopelagicales o__Candidatus Nanosynbacterales
##                            3                              3
##              o__Glycomycetales         o__Jatrophihabitantales
##                            3                              3
##                o__Jiangellales                o__Kosmotogales
##                            3                              3
##             o__Mariprofundales            o__Miltoncostaeales
##                            3                              3
##            o__Natranaerobiales             o__Phycisphaerales
##                            3                              3
##            o__Silvanigrellales              o__Tepidiformales
##                            3                              3
##          o__Vicinamibacterales         o__Acidiferrobacterales
##                            3                              4
##           o__Bdellovibrionales              o__Bradymonadales
##                            4                              4
##           o__Cardiobacteriales                o__Chlamydiales
##                            4                              4
##                o__Maricaulales              o__Nakamurellales
##                            4                              4
##                  o__Nevskiales                     o__Orbales
##                            4                              4
##              o__Rhodothermales     o__Thermodesulfobacteriales
##                            4                              4
##    o__Thermosediminibacterales                 o__Aquificales
##                            4                              5
##              o__Brachyspirales              o__Chloroflexales
##                            5                              5
##             o__Gloeobacterales               o__Nitrospirales
##                            5                              5
##            o__Parachlamydiales        o__Acidithiobacillales
##                            5                              6
##           o__Deferribacterales            o__Gemmatimonadales
##                            6                              6
##                o__Holosporales              o__Hyphomonadales
##                            6                              6
##               o__Isosphaerales            o__Marinilabiliales
##                            6                              6
##                 o__Nautiliales                o__Petrotogales
```

```
##                          6                          6
##     o__Geodermatophilales        o__Halanaerobiales
##                          7                          7
##            o__Moorellales              o__Opitutales
##                          7                          7
##    o__Sedimentisphaerales          o__Thermotogales
##                          7                          7
##      o__Acidaminococcales              o__Frankiales
##                          8                          8
##             o__Gemmatales        o__Oscillatoriales
##                          8                          8
##    o__Solirubrobacterales       o__Acidimicrobiales
##                          8                          9
##           o__Polyangiales      o__Acholeplasmatales
##                          9                         10
##          o__Leptospirales        o__Rubrobacterales
##                         10                         10
##          o__Chroococcales        o__Desulfobulbales
##                         11                         11
##       o__Mycoplasmoidales          o__Legionellales
##                         11                         12
##     o__Verrucomicrobiales    o__Desulfuromonadales
##                         13                         14
##          o__Rickettsiales          o__Synergistales
##                         14                         15
##       o__Pseudanabaenales         o__Veillonellales
##                         16                         16
##      o__Desulfobacterales      o__Entomoplasmatales
##                         17                         17
##       o__Planctomycetales        o__Selenomonadales
##                         17                         17
##           o__Chlorobiales          o__Terriglobales
##                         18                         18
##              o__Thermales         o__Eggerthellales
##                         18                         20
##          o__Thiotrichales       o__Coriobacteriales
##                         20                         21
##          o__Geobacterales           o__Pirellulales
##                         22                         22
##        o__Chitinophagales          o__Deinococcales
##                         23                         25
##       o__Methylococcales              o__Nostocales
##                         25                         25
##         o__Tissierellales           o__Myxococcales
##                         25                         26
## o__Thermoanaerobacterales          o__Aeromonadales
##                         26                         27
##        o__Fusobacteriales        o__Mycoplasmatales
##                         29                         30
##     o__Erysipelotrichales        o__Cellvibrionales
##                         32                         34
##         o__Pasteurellales     o__Sphingobacteriales
##                         35                         35
##    o__Streptosporangiales       o__Nitrosomonadales
```

```
##                         36                               37
##              o__Rhodocyclales                            o__
##                         37                               38
##          o__Bifidobacteriales                o__Caulobacterales
##                         39                               41
##             o__Spirochaetales                o__Synechococcales
##                         44                               47
##         o__Desulfovibrionales                   o__Chromatiales
##                         48                               49
##               o__Moraxellales                    o__Vibrionales
##                         50                               52
##            o__Actinomycetales                o__Alteromonadales
##                         58                               58
##          o__Pseudonocardiales              o__Campylobacterales
##                         67                               69
##               o__Neisseriales              o__Micromonosporales
##                         70                               74
##          o__Oceanospirillales                   o__Cytophagales
##                         78                               84
##           o__Rhodospirillales                o__Xanthomonadales
##                         91                              102
##        o__Propionibacteriales                  o__Bacteroidales
##                        108                              116
##           o__Flavobacteriales                o__Rhodobacterales
##                        147                              160
##           o__Sphingomonadales                o__Pseudomonadales
##                        174                              190
##           o__Enterobacterales               o__Kitasatosporales
##                        254                              256
##            o__Lactobacillales                o__Mycobacteriales
##                        296                              303
##              o__Eubacteriales                o__Burkholderiales
##                        308                              342
##           o__Hyphomicrobiales                  o__Micrococcales
##                        362                              436
##                o__Bacillales
##                        483
```

```
sort(table(tax_table(subsetMG)[, "Family"]))
```

```
##
##                          f__Acanthopleuribacteraceae
##                                                    1
##                                 f__Acetomicrobiaceae
##                                                    1
##                              f__Acidilutibacteraceae
##                                                    1
##                                 f__Acidimicrobiaceae
##                                                    1
##                                   f__Acidothermaceae
##                                                    1
##                              f__Actinopolymorphaceae
##                                                    1
##                               f__Actinopolysporaceae
```

```
##                                                    1
##                               f__Aminithiophilaceae
##                                                    1
##                                  f__Amoebophilaceae
##                                                    1
##                                      f__Amorphaceae
##                                                    1
##                            f__Anaerohalosphaeraceae
##                                                    1
##            f__Bacillales Family X. Incertae Sedis
##                                                    1
##                                   f__Breoghaniaceae
##                                                    1
##                                  f__Bryobacteraceae
##                                                    1
##                                  f__Caedimonadaceae
##                                                    1
##                                   f__Caldilineaceae
##                                                    1
##                                  f__Caldisericaceae
##                                                    1
##                           f__Calditerrivibrionaceae
##                                                    1
##                                  f__Calditrichaceae
##                                                    1
##                           f__Candidatus Babeliaceae
##                                                    1
##                          f__Candidatus Brocadiaceae
##                                                    1
##                    f__Candidatus Chromulinivoraceae
##                                                    1
##                     f__Candidatus Izemoplasmataceae
##                                                    1
##                  f__Candidatus Paracaedibacteraceae
##                                                    1
##                    f__Candidatus Saccharimonadaceae
##                                                    1
##                             f__Capillimicrobiaceae
##                                                    1
##                                 f__Casimicrobiaceae
##                                                    1
##                                f__Catenulisporaceae
##                                                    1
##                          f__Celerinatantimonadaceae
##                                                    1
##                                f__Chamaesiphonaceae
##                                                    1
##                              f__Chloroherpetonaceae
##                                                    1
##                              f__Christensenellaceae
##                                                    1
##                           f__Chroococcidiopsidaceae
##                                                    1
##                                  f__Chrysiogenaceae
```

```
##                                                1
##                               f__Chthonomonadaceae
##                                                1
##            f__Clostridiales Family XVI. Incertae Sedis
##                                                1
##                              f__Cohaesibacteraceae
##                                                1
##                          f__Coprothermobacteraceae
##                                                1
##                                    f__Coxiellaceae
##                                                1
##                               f__Cyclonatronaceae
##                                                1
##                              f__Deferribacteraceae
##                                                1
##                                   f__Demequinaceae
##                                                1
##                               f__Dermocarpellaceae
##                                                1
##                                  f__Desulfallaceae
##                                                1
##                               f__Desulfarculaceae
##                                                1
##                           f__Desulfatibacillaceae
##                                                1
##                               f__Desulfobaccaceae
##                                                1
##                             f__Desulfohalobiaceae
##                                                1
##                                 f__Desulfolunaceae
##                                                1
##                              f__Desulfomonilaceae
##                                                1
##                                 f__Desulfosudaceae
##                                                1
##                            f__Desulfotomaculaceae
##                                                1
##                            f__Dissulfurispiraceae
##                                                1
##                                  f__Egibacteraceae
##                                                1
##                                    f__Egicoccaceae
##                                                1
##                                    f__Elioraeaceae
##                                                1
##                              f__Elusimicrobiaceae
##                                                1
##                                     f__Euzebyaceae
##                                                1
##                                     f__Ferrovaceae
##                                                1
##                               f__Fibrobacteraceae
##                                                1
##                              f__Fimbriimonadaceae
```

```
##                                              1
##                          f__Flexistipitaceae
##                                              1
##                          f__Fontisphaeraceae
##                                              1
##                            f__Fulvivirgaceae
##                                              1
##                           f__Geminicoccaceae
##                                              1
##                           f__Geminocystaceae
##                                              1
##                        f__Gloeomargaritaceae
##                                              1
##                          f__Gomontiellaceae
##                                              1
##                         f__Gottschalkiaceae
##                                              1
##                       f__Granulosicoccaceae
##                                              1
##                  f__Haliscomenobacteraceae
##                                              1
##                    f__Halothermotrichaceae
##                                              1
##                               f__Hippeaceae
##                                              1
##                      f__Hydrogenimonadaceae
##                                              1
##                       f__Hydrogenophilaceae
##                                              1
##                      f__Hydrogenothermaceae
##                                              1
##                               f__Hyellaceae
##                                              1
##                      f__Ichthyobacteriaceae
##                                              1
##                       f__Ilumatobacteraceae
##                                              1
##                  f__Immundisolibacteraceae
##                                              1
##                              f__Jonesiaceae
##                                              1
##                              f__Kaistiaceae
##                                              1
##                           f__Kiloniellaceae
##                                              1
##                          f__Kineosporiaceae
##                                              1
##                       f__Kiritimatiellaceae
##                                              1
##                             f__Kofleriaceae
##                                              1
##                         f__Koleobacteraceae
##                                              1
##                         f__Kordiimonadaceae
```

```
##                                            1
##                 f__Ktedonosporobacteraceae
##                                            1
##                           f__Kytococcaceae
##                                            1
##                        f__Labilitrichaceae
##                                            1
##                          f__Lawsonellaceae
##                                            1
##                        f__Lentisphaeraceae
##                                            1
##                         f__Limnochordaceae
##                                            1
##                        f__Magnetococcaceae
##                                            1
##                       f__Maliibacteriaceae
##                                            1
##                           f__Marivirgaceae
##                                            1
##                       f__Mesoaciditogaceae
##                                            1
##                       f__Microvenatoraceae
##                                            1
##                        f__Mucispirillaceae
##                                            1
##                          f__Nannocystaceae
##                                            1
##                       f__Natranaerobiaceae
##                                            1
##                      f__Natranaerofabaceae
##                                            1
##                          f__Nitrospinaceae
##                                            1
##                           f__Oleiphilaceae
##                                            1
##                       f__Paludibacteraceae
##                                            1
##                   f__Paraconexibacteraceae
##                                            1
##                          f__Parvicellaceae
##                                            1
##                      f__Persicobacteraceae
##                                            1
##                       f__Phototrophicaceae
##                                            1
##                    f__Pleomorphomonadaceae
##                                            1
##                     f__Prochlorotrichaceae
##                                            1
##                        f__Proteinivoraceae
##                                            1
##                       f__Psychromonadaceae
##                                            1
##                    f__Reichenbachiellaceae
```

```
##                                                        1
##                                         f__Rivulariaceae
##                                                        1
##                                     f__Salinibacteraceae
##                                                        1
##                                     f__Salinisphaeraceae
##                                                        1
##                                       f__Salinivirgaceae
##                                                        1
##                                       f__Sandaracinaceae
##                                                        1
##                                        f__Saprospiraceae
##                                                        1
##                                       f__Schleiferiaceae
##                                                        1
##                                       f__Segniliparaceae
##                                                        1
##                                          f__Simkaniaceae
##                                                        1
##                                       f__Sneathiellaceae
##                                                        1
##                                    f__Sphaerobacteraceae
##                                                        1
##                                       f__Sporichthyaceae
##                                                        1
##                                            f__Stellaceae
##                                                        1
##                                   f__Steroidobacteraceae
##                                                        1
##                                   f__Succinivibrionaceae
##                                                        1
##                                        f__Syntrophaceae
##                                                        1
##                                     f__Tepidisphaeraceae
##                                                        1
##                                    f__Thalassobaculaceae
##                                                        1
##                                       f__Thermincolaceae
##                                                        1
##   f__Thermoanaerobacterales Family IV. Incertae Sedis
##                                                        1
##                                   f__Thermodesulfobiaceae
##                                                        1
##                              f__Thermodesulfovibrionaceae
##                                                        1
##                                       f__Thermoguttaceae
##                                                        1
##                                  f__Thermohalobacteraceae
##                                                        1
##                                    f__Thermoleophilaceae
##                                                        1
##                                    f__Thermomicrobiaceae
##                                                        1
##                              f__Thermosediminibacteraceae
```

```
##                                                        1
##                                      f__Thermostichaceae
##                                                        1
##                                    f__Thermotomaculaceae
##                                                        1
##                                       f__Thermovirgaceae
##                                                        1
##                                 f__Thioalkalibacteraceae
##                                                        1
##                                   f__Thioalkalispiraceae
##                                                        1
##                                      f__Tichowtungiaceae
##                                                        1
##                                     f__Trichocoleusaceae
##                                                        1
##                                         f__Trueperaceae
##                                                        1
##                                    f__Vulgatibacteraceae
##                                                        1
##                                          f__Waddliaceae
##                                                        1
##                                          f__Woeseiaceae
##                                                        1
##                                        f__Zhaonellaceae
##                                                        1
##                                      f__Zooshikellaceae
##                                                        1
##                                       f__Zymomonadaceae
##                                                        1
##                                     f__Aminobacteriaceae
##                                                        2
##                                      f__Beutenbergiaceae
##                                                        2
##                                    f__Blattabacteriaceae
##                                                        2
##                           f__Candidatus Midichloriaceae
##                                                        2
##                                      f__Chelatococcaceae
##                                                        2
##                                       f__Chloroflexaceae
##                                                        2
##                                        f__Chroococcaceae
##                                                        2
##                                    f__Coleofasciculaceae
##                                                        2
##                                    f__Dehalococcoidaceae
##                                                        2
##                                 f__Desulfurobacteriaceae
##                                                        2
##                                       f__Dictyoglomaceae
##                                                        2
##                                     f__Dysgonomonadaceae
##                                                        2
##                                       f__Emcibacteraceae
```

```
##                                                  2
##                                 f__Endomicrobiaceae
##                                                  2
##                                  f__Ferrimonadaceae
##                                                  2
##                                  f__Geovibrionaceae
##                                                  2
##                                      f__Hahellaceae
##                                                  2
##                                 f__Halanaerobiaceae
##                                                  2
##                             f__Halobacteriovoraceae
##                                                  2
##                              f__Halothiobacillaceae
##                                                  2
##                                f__Heliobacteriaceae
##                                                  2
##                                    f__Kangiellaceae
##                                                  2
##                             f__Lichenihabitantaceae
##                                                  2
##                                f__Marinilabiliaceae
##                                                  2
##                             f__Methylacidiphilaceae
##                                                  2
##                                   f__Microcoleaceae
##                                                  2
##                                   f__Microcystaceae
##                                                  2
##                                    f__Moritellaceae
##                                                  2
##                                     f__Nautiliaceae
##                                                  2
##                                 f__Oscillatoriaceae
##                                                  2
##                                f__Parachlamydiaceae
##                                                  2
##                                 f__Parvularculaceae
##                                                  2
##                                f__Pelagibacteraceae
##                                                  2
##                                f__Pseudanabaenaceae
##                                                  2
##                                 f__Puniceicoccaceae
##                                                  2
##                                f__Sanguibacteraceae
##                                                  2
##                            f__Sporolactobacillaceae
##                                                  2
##                             f__Syntrophobacteraceae
##                                                  2
##                                  f__Thiobacillaceae
##                                                  2
##                                  f__Tissierellaceae
```

```
##                                        2
##                     f__Usitatibacteraceae
##                                        2
##                   f__Wenzhouxiangellaceae
##                                        2
##                     f__Acaryochloridaceae
##                                        3
##                        f__Akkermansiaceae
##                                        3
##                        f__Anaerolineaceae
##                                        3
##                           f__Baekduiaceae
##                                        3
##                        f__Barnesiellaceae
##                                        3
##                       f__Beijerinckiaceae
##                                        3
##                     f__Blastochloridaceae
##                                        3
##                        f__Bradymonadaceae
##                                        3
##                           f__Budviciaceae
##                                        3
##            f__Candidatus Nanopelagicaceae
##                                        3
##          f__Candidatus Nanosynbacteraceae
##                                        3
##                    f__Cellulosilyticaceae
##                                        3
##                       f__Dermatophilaceae
##                                        3
##                       f__Desulfococcaceae
##                                        3
##                 f__Dethiosulfovibrionaceae
##                                        3
##                     f__Entomoplasmataceae
##                                        3
##                    f__Fervidobacteriaceae
##                                        3
##                   f__Geoalkalibacteraceae
##                                        3
##                        f__Glycomycetaceae
##                                        3
##                     f__Halobacteroidaceae
##                                        3
##                         f__Holosporaceae
##                                        3
##                  f__Jatrophihabitantaceae
##                                        3
##                         f__Jiangellaceae
##                                        3
##                         f__Kosmotogaceae
##                                        3
##                      f__Mariprofundaceae
```

```
##                                                  3
##                                f__Miltoncostaeaceae
##                                                  3
##                                f__Mycoplasmoidaceae
##                                                  3
##                               f__Phreatobacteraceae
##                                                  3
##                                 f__Phycisphaeraceae
##                                                  3
##                                  f__Rhodothermaceae
##                                                  3
##                                   f__Roseiflexaceae
##                                                  3
##                            f__Saccharospirillaceae
##                                                  3
##                                  f__Scytonemataceae
##                                                  3
##                                f__Silvanigrellaceae
##                                                  3
##                                  f__Sinobacteraceae
##                                                  3
##                              f__Sulfurospirillaceae
##                                                  3
##                               f__Symbiobacteriaceae
##                                                  3
##                               f__Syntrophotaleaceae
##                                                  3
##                          f__Tepidanaerobacteraceae
##                                                  3
##                                  f__Tepidiformaceae
##                                                  3
##                               f__Tepidimicrobiaceae
##                                                  3
##                                   f__Thiotrichaceae
##                                                  3
##                              f__Vicinamibacteraceae
##                                                  3
##                           f__Acidiferrobacteraceae
##                                                  4
##                                  f__Anaplasmataceae
##                                                  4
##                               f__Aphanizomenonaceae
##                                                  4
##                                     f__Aquificaceae
##                                                  4
##                                 f__Breznakiellaceae
##                                                  4
##                               f__Cardiobacteriaceae
##                                                  4
##                                    f__Chlamydiaceae
##                                                  4
##           f__Clostridiales Family XVII. Incertae Sedis
##                                                  4
##                                 f__Desulfocapsaceae
```

```
##                                        4
##                          f__Kribbellaceae
##                                        4
##                          f__Maricaulaceae
##                                        4
##                        f__Nakamurellaceae
##                                        4
##                     f__Nitratiruptoraceae
##                                        4
##                               f__Orbaceae
##                                        4
##                        f__Parvibaculaceae
##                                        4
##                     f__Prolixibacteraceae
##                                        4
##               f__Pseudobdellovibrionaceae
##                                        4
##                     f__Spongiibacteraceae
##                                        4
##                          f__Sporomusaceae
##                                        4
##                      f__Sulfuricellaceae
##                                        4
##              f__Thermodesulfobacteriaceae
##                                        4
##                 f__Thermosynechococcaceae
##                                        4
##                         f__Thermotogaceae
##                                        4
##                        f__Aphanothecaceae
##                                        5
##                         f__Bogoriellaceae
##                                        5
##                           f__Borreliaceae
##                                        5
##                        f__Brachyspiraceae
##                                        5
##                    f__Bruguierivoracaceae
##                                        5
##                         f__Calotrichaceae
##                                        5
##                          f__Colwelliaceae
##                                        5
##                      f__Conexibacteraceae
##                                        5
##                         f__Dermacoccaceae
##                                        5
##                     f__Desulfobacteraceae
##                                        5
##                     f__Desulfosarcinaceae
##                                        5
##                    f__Endozoicomonadaceae
##                                        5
##                      f__Gloeobacteraceae
```

```
##                                    5
##                          f__Halieaceae
##                                    5
##                       f__Nitrospiraceae
##                                    5
##                      f__Odoribacteraceae
##                                    5
##                  f__Sedimentisphaeraceae
##                                    5
##                    f__Sphaerochaetaceae
##                                    5
##                   f__Syntrophomonadaceae
##                                    5
##                     f__Tsukamurellaceae
##                                    5
##                    f__Turicibacteraceae
##                                    5
##                       f__Vallitaleaceae
##                                    5
##                  f__Acidithiobacillaceae
##                                    6
##                 f__Anaeromyxobacteraceae
##                                    6
##                        f__Archangiaceae
##                                    6
##                       f__Bartonellaceae
##                                    6
##                    f__Coriobacteriaceae
##                                    6
##                   f__Desulfomicrobiaceae
##                                    6
##                    f__Gemmatimonadaceae
##                                    6
##                          f__Hafniaceae
##                                    6
##                      f__Hyphomonadaceae
##                                    6
##                       f__Isosphaeraceae
##                                    6
##                         f__Moorellaceae
##                                    6
##                        f__Petrotogaceae
##                                    6
##                        f__Polyangiaceae
##                                    6
##                    f__Porphyromonadaceae
##                                    6
##                       f__Rickettsiaceae
##                                    6
##                          f__Ruaniaceae
##                                    6
##                      f__Rubrobacteraceae
##                                    6
##                  f__Sphingosinicellaceae
```

```
##                                         6
##                     f__Sterolibacteriaceae
##                                         6
##                          f__Sutterellaceae
##                                         6
##                          f__Synergistaceae
##                                         6
##                       f__Thalassospiraceae
##                                         6
##                             f__Azonexaceae
##                                         7
##                         f__Desulfobulbaceae
##                                         7
##                    f__Desulfuromonadaceae
##                                         7
##                        f__Gallionellaceae
##                                         7
##                    f__Geodermatophilaceae
##                                         7
##                              f__Iamiaceae
##                                         7
##                      f__Lacipirellulaceae
##                                         7
##                   f__Metamycoplasmataceae
##                                         7
##                       f__Methylophilaceae
##                                         7
##                         f__Muribaculaceae
##                                         7
##                            f__Opitutaceae
##                                         7
##                     f__Prochlorococcaceae
##                                         7
##                      f__Sulfurimonadaceae
##                                         7
##                          f__Sulfurovaceae
##                                         7
##                     f__Acidaminococcaceae
##                                         8
##                       f__Alcanivoracaceae
##                                         8
##                             f__Boseaceae
##                                         8
##                       f__Coprobacillaceae
##                                         8
##                            f__Dietziaceae
##                                         8
##                        f__Francisellaceae
##                                         8
##                            f__Frankiaceae
##                                         8
##                            f__Gemmataceae
##                                         8
##                       f__Leptolyngbyaceae
```

```
##                                                 8
##                              f__Nitrosomonadaceae
##                                                 8
##                           f__Thermoactinomycetaceae
##                                                 8
##                               f__Cellvibrionaceae
##                                                 9
##                              f__Cyclobacteriaceae
##                                                 9
##         f__Eubacteriales Family XIII. Incertae Sedis
##                                                 9
##                            f__Piscirickettsiaceae
##                                                 9
##                               f__Spirochaetaceae
##                                                 9
##                           f__Streptosporangiaceae
##                                                 9
##                            f__Verrucomicrobiaceae
##                                                 9
##                             f__Acholeplasmataceae
##                                                10
##                                 f__Aerococcaceae
##                                                10
##                              f__Hyphomicrobiaceae
##                                                10
##                                f__Legionellaceae
##                                                10
##                                f__Leptospiraceae
##                                                10
##                                  f__Listeriaceae
##                                                10
##                              f__Methylocystaceae
##                                                10
##                                f__Rhodocyclaceae
##                                                10
##                                   f__Nostocaceae
##                                                11
##                                f__Peptococcaceae
##                                                11
##                         f__Pseudoalteromonadaceae
##                                                11
##                                 f__Rikenellaceae
##                                                11
##                                   f__Stappiaceae
##                                                11
##                                f__Tannerellaceae
##                                                11
##                       f__Thermoanaerobacteraceae
##                                                11
##                          f__Thermomonosporaceae
##                                                11
##                            f__Aurantimonadaceae
##                                                12
##                                 f__Cytophagaceae
```

```
##                                                   12
##                                  f__Helicobacteraceae
##                                                   12
##                                f__Intrasporangiaceae
##                                                   12
##                                  f__Selenomonadaceae
##                                                   12
##                                 f__Spiroplasmataceae
##                                                   12
## f__Thermoanaerobacterales Family III. Incertae Sedis
##                                                   12
##                                  f__Leptotrichiaceae
##                                                   13
##                                      f__Myxococcaceae
##                                                   13
##                             f__Promicromonosporaceae
##                                                   13
##                                 f__Rhodospirillaceae
##                                                   13
##                                      f__Atopobiaceae
##                                                   14
##                                   f__Eubacteriaceae
##                                                   14
##                                     f__Pirellulaceae
##                                                   14
##                                  f__Alteromonadaceae
##                                                   15
##                                   f__Arcobacteraceae
##                                                   15
##                                      f__Brucellaceae
##                                                   15
##                             f__Desulfitobacteriaceae
##                                                   15
##                                  f__Fusobacteriaceae
##                                                   15
##                                f__Microbulbiferaceae
##                                                   15
##                                  f__Nocardiopsaceae
##                                                   15
##                             f__Ornithinimicrobiaceae
##                                                   15
##                                     f__Spirosomaceae
##                                                   15
##                                  f__Peptoniphilaceae
##                                                   16
##                             f__Peptostreptococcaceae
##                                                   16
##                                  f__Veillonellaceae
##                                                   16
##                                     f__Chlorobiaceae
##                                                   17
##                                 f__Marinobacteraceae
##                                                   17
##                                f__Oceanospirillaceae
```

```
##                                            17
##                          f__Planctomycetaceae
##                                            17
##                            f__Sphaerotilaceae
##                                            17
##                          f__Acidobacteriaceae
##                                            18
##                        f__Alicyclobacillaceae
##                                            18
##                              f__Chromatiaceae
##                                            18
##                           f__Dermabacteraceae
##                                            18
##                        f__Erysipelotrichaceae
##                                            18
##                               f__Gordoniaceae
##                                            18
##                                 f__Thermaceae
##                                            18
##                          f__Xanthobacteraceae
##                                            18
##                     f__Ectothiorhodospiraceae
##                                            19
##                            f__Morganellaceae
##                                            19
##                               f__Zoogloeaceae
##                                            19
##                          f__Carnobacteriaceae
##                                            20
##                            f__Eggerthellaceae
##                                            20
##                            f__Treponemataceae
##                                            20
##                             f__Shewanellaceae
##                                            21
##                          f__Brevibacteriaceae
##                                            22
##                             f__Geobacteraceae
##                                            22
##                            f__Azospirillaceae
##                                            23
##                         f__Campylobacteraceae
##                                            23
##                           f__Chitinophagaceae
##                                            23
##                                f__Devosiaceae
##                                            23
##                          f__Pectobacteriaceae
##                                            23
##                             f__Deinococcaceae
##                                            25
##                           f__Methylococcaceae
##                                            25
##                         f__Rhodanobacteraceae
```

```
##                                                   25
##                                    f__Aeromonadaceae
##                                                   26
##                                  f__Cellulomonadaceae
##                                                   27
##                                 f__Chromobacteriaceae
##                                                   30
##                                f__Methylobacteriaceae
##                                                   30
##                                  f__Mycoplasmataceae
##                                                   30
##                                    f__Prevotellaceae
##                                                   31
##                                    f__Planococcaceae
##                                                   34
##                                  f__Synechococcaceae
##                                                   34
##                                       f__Erwiniaceae
##                                                   35
##                                   f__Pasteurellaceae
##                                                   35
##                                f__Sphingobacteriaceae
##                                                   35
##                                    f__Bacteroidaceae
##                                                   37
##                               f__Propionibacteriaceae
##                                                   37
##                                      f__Yersiniaceae
##                                                   37
##                                 f__Bifidobacteriaceae
##                                                   39
##                                     f__Neisseriaceae
##                                                   39
##                                f__Desulfovibrionaceae
##                                                   40
##                                    f__Halomonadaceae
##                                                   40
##                                  f__Caulobacteraceae
##                                                   41
##                                    f__Alcaligenaceae
##                                                   42
##                                   f__Enterococcaceae
##                                                   42
##                                 f__Erythrobacteraceae
##                                                   42
##                                  f__Hymenobacteraceae
##                                                   42
##                                  f__Acetobacteraceae
##                                                   43
##                                     f__Weeksellaceae
##                                                   45
##                                     f__Moraxellaceae
##                                                   50
##                                  f__Oscillospiraceae
```

```
##                                               52
##                                   f__Vibrionaceae
##                                               52
##                                   f__Nocardiaceae
##                                               53
##                             f__Phyllobacteriaceae
##                                               54
##                               f__Actinomycetaceae
##                                               58
##                               f__Oxalobacteraceae
##                                               59
##                               f__Nitrobacteraceae
##                                               63
##                                f__Nocardioidaceae
##                                               65
##                             f__Pseudonocardiaceae
##                                               67
##                              f__Staphylococcaceae
##                                               73
##                               f__Streptococcaceae
##                                               73
##                             f__Micromonosporaceae
##                                               74
##                                f__Lachnospiraceae
##                                               75
##                                   f__Rhizobiaceae
##                                               76
##                               f__Xanthomonadaceae
##                                               76
##                               f__Roseobacteraceae
##                                               79
##                                  f__Paracoccaceae
##                                               80
##                                 f__Clostridiaceae
##                                               82
##                              f__Flavobacteriaceae
##                                               94
##                                 f__Comamonadaceae
##                                               98
##                             f__Corynebacteriaceae
##                                              101
##                               f__Burkholderiaceae
##                                              108
##                                 f__Micrococcaceae
##                                              110
##                               f__Mycobacteriaceae
##                                              112
##                               f__Paenibacillaceae
##                                              122
##                              f__Sphingomonadaceae
##                                              124
##                             f__Enterobacteriaceae
##                                              125
##                                              f__
```

```
##                                                137
##                                 f__Lactobacillaceae
##                                                150
##                                 f__Pseudomonadaceae
##                                                172
##                                f__Microbacteriaceae
##                                                190
##                                      f__Bacillaceae
##                                                200
##                                f__Streptomycetaceae
##                                                256
```

```
sort(table(tax_table(subsetMG)[, "Genus"]))
```

```
##
##                          g__Abiotrophia
##                                       1
##                           g__Abyssalbus
##                                       1
##                           g__Abyssibius
##                                       1
##                         g__Abyssicoccus
##                                       1
##                   g__Acetilactobacillus
##                                       1
##                      g__Acetoanaerobium
##                                       1
##                        g__Acetohalobium
##                                       1
##                       g__Acetomicrobium
##                                       1
##                  g__Acidibrevibacterium
##                                       1
##                 g__Acididesulfobacillus
##                                       1
##                     g__Acidilutibacter
##                                       1
##                      g__Acidimicrobium
##                                       1
##                        g__Acidisarcina
##                                       1
##                      g__Acidobacterium
##                                       1
##                          g__Acidocella
##                                       1
##                        g__Acidothermus
##                                       1
##                       g__Actibacterium
##                                       1
##                     g__Actinacidiphila
##                                       1
##                       g__Actinobaculum
##                                       1
##                    g__Actinokineospora
```

```
##                                                  1
##                                g__Actinomarinicola
##                                                  1
##                                g__Actinopolymorpha
##                                                  1
##                                 g__Actinopolyspora
##                                                  1
##                                     g__Actinotalea
##                                                  1
##                                    g__Actinotignum
##                                                  1
##                                   g__Acutalibacter
##                                                  1
##                                     g__Acuticoccus
##                                                  1
##                                      g__Adhaeretor
##                                                  1
##                                   g__Adhaeribacter
##                                                  1
##                                       g__Advenella
##                                                  1
##                                       g__Aeoliella
##                                                  1
##                                     g__Aequorivita
##                                                  1
##                                    g__Aeribacillus
##                                                  1
##                                      g__Aerosticca
##                                                  1
##                                  g__Aestuariispira
##                                                  1
##                                     g__Agarivorans
##                                                  1
##                                          g__Agreia
##                                                  1
##                                        g__Ahniella
##                                                  1
##                                      g__Algibacter
##                                                  1
##                                  g__Alicycliphilus
##                                                  1
##                                     g__Alienimonas
##                                                  1
##                                    g__Alkalibacter
##                                                  1
##                                     g__Alkalicella
##                                                  1
##                                    g__Alkaliflexus
##                                                  1
##                                 g__Alkalilimnicola
##                                                  1
##                                   g__Alkalimarinus
##                                                  1
##                                     g__Alkalitalea
```

```
##                                                  1
##                               g__Alloacidobacterium
##                                                  1
##                                g__Alloactinosynnema
##                                                  1
##                                     g__Allobacillus
##                                                  1
##                                 g__Allobranchiibius
##                                                  1
##                                    g__Allocoleopsis
##                                                  1
##                                    g__Allokutzneria
##                                                  1
##                                  g__Allomeiothermus
##                                                  1
##                                    g__Allorhizobium
##                                                  1
##                            g__Allosaccharopolyspora
##                                                  1
##                             g__Allosphingosinicella
##                                                  1
##                                g__Alteracholeplasma
##                                                  1
##                                   g__Amedibacterium
##                                                  1
##                                  g__Aminithiophilus
##                                                  1
##                                   g__Aminobacterium
##                                                  1
##                                       g__Aminomonas
##                                                  1
##                                        g__Ammonifex
##                                                  1
##                                g__Amniculibacterium
##                                                  1
##                                    g__Amphibacillus
##                                                  1
##                                      g__Amylibacter
##                                                  1
##                               g__Amylolactobacillus
##                                                  1
##                                     g__Anabaenopsis
##                                                  1
##                                   g__Anaerobacillus
##                                                  1
##                                  g__Anaerobutyricum
##                                                  1
##                                g__Anaerohalosphaera
##                                                  1
##                                      g__Anaerolinea
##                                                  1
##                                  g__Anaeromicropila
##                                                  1
##                              g__Anaeropeptidivorans
```

```
##                                                1
##                                 g__Anaerotignum
##                                                1
##                                g__Anaerotruncus
##                                                1
##                                    g__Anaplasma
##                                                1
##                                  g__Anoxybacter
##                                                1
##                                  g__Anseongella
##                                                1
##                           g__Antarcticibacterium
##                                                1
##                                 g__Antarctobacter
##                                                1
##                             g__Anthocerotibacter
##                                                1
##                                    g__Apibacter
##                                                1
##                                   g__Aquabacter
##                                                1
##                                g__Aquaspirillum
##                                                1
##                                      g__Aquella
##                                                1
##                                    g__Aquicella
##                                                1
##                                      g__Aquifex
##                                                1
##                                   g__Aquiflexum
##                                                1
##                                     g__Aquiluna
##                                                1
##                                    g__Aquincola
##                                                1
##                                g__Aquisalimonas
##                                                1
##                                  g__Aquisalinus
##                                                1
##                                  g__Aquisphaera
##                                                1
##                                 g__Arabiibacter
##                                                1
##                             g__Arcticibacterium
##                                                1
##                                  g__Arenibacter
##                                                1
##                                   g__Arenimonas
##                                                1
##                                 g__Aristophania
##                                                1
##                               g__Arsenicicoccus
##                                                1
##                                        g__Asaia
```

```
##                                          1
##                           g__Athalassotoga
##                                          1
##                           g__Atlantibacter
##                                          1
##                               g__Atopobium
##                                          1
##                            g__Aurantimonas
##                                          1
##                            g__Auraticoccus
##                                          1
##                              g__Aureliella
##                                          1
##                              g__Austwickia
##                                          1
##                            g__Azorhizobium
##                                          1
##                          g__Bacterioplanes
##                                          1
##                       g__Bacterioplanoides
##                                          1
##                             g__Barnesiella
##                                          1
##                                  g__Basfia
##                                          1
##                                 g__Basilea
##                                          1
##                            g__Beijerinckia
##                                          1
##                               g__Belliella
##                                          1
##                              g__Bergeyella
##                                          1
##                              g__Bermanella
##                                          1
##                            g__Beutenbergia
##                                          1
##                              g__Bhargavaea
##                                          1
##                            g__Bibersteinia
##                                          1
##                            g__Biomaibacter
##                                          1
##                             g__Blastomonas
##                                          1
##                         g__Blastopirellula
##                                          1
##                             g__Botrimarina
##                                          1
##                             g__Boudabousia
##                                          1
##                              g__Bradymonas
##                                          1
##                             g__Brasilonema
```

```
##                                        1
##                             g__Bremerella
##                                        1
##                             g__Breoghania
##                                        1
##                             g__Brevefilum
##                                        1
##                           g__Brevirhabdus
##                                        1
##                           g__Breznakiella
##                                        1
##                            g__Brochothrix
##                                        1
##                           g__Brucepastera
##                                        1
##                               g__Buchnera
##                                        1
##                              g__Bulleidia
##                                        1
##                         g__Butyricicoccus
##                                        1
##                         g__Bythopirellula
##                                        1
##                     g__Caldalkalibacillus
##                                        1
##                       g__Caldanaerobacter
##                                        1
##                          g__Caldibacillus
##                                        1
##                             g__Caldilinea
##                                        1
##                    g__Caldinitratiruptor
##                                        1
##                           g__Caldisericum
##                                        1
##                       g__Calditerrivibrio
##                                        1
##                             g__Caldithrix
##                                        1
##                      g__Caloranaerobacter
##                                        1
##                           g__Caminibacter
##                                        1
##                g__Candidatus Amoebophilus
##                                        1
##         g__Candidatus Atelocyanobacterium
##                                        1
##                      g__Candidatus Babela
##                                        1
##                   g__Candidatus Baumannia
##                                        1
##              g__Candidatus Bipolaricaulis
##                                        1
##                 g__Candidatus Blochmannia
```

```
##                                          1
##               g__Candidatus Chromulinivorax
##                                          1
##                 g__Candidatus Contubernalis
##                                          1
##                  g__Candidatus Desulforudis
##                                          1
##                    g__Candidatus Endoriftia
##                                          1
##                    g__Candidatus Formimonas
##                                          1
##                  g__Candidatus Hepatoplasma
##                                          1
##           g__Candidatus Hydrogenosomobacter
##                                          1
##                   g__Candidatus Karelsulcia
##                                          1
##                    g__Candidatus Koribacter
##                                          1
##                      g__Candidatus Kuenenia
##                                          1
##                       g__Candidatus Megaira
##                                          1
##                  g__Candidatus Methylospira
##                                          1
##                   g__Candidatus Midichloria
##                                          1
##                 g__Candidatus Mycosynbacter
##                                          1
##                 g__Candidatus Nanopelagicus
##                                          1
##                  g__Candidatus Nesciobacter
##                                          1
##             g__Candidatus Nitrosacidococcus
##                                          1
##                 g__Candidatus Nitrosoglobus
##                                          1
##                     g__Candidatus Nitrotoga
##                                          1
##                 g__Candidatus Nucleicultrix
##                                          1
##               g__Candidatus Paracaedibacter
##                                          1
##              g__Candidatus Paraluminiphilus
##                                          1
##             g__Candidatus Phaeomarinobacter
##                                          1
##               g__Candidatus Phycorickettsia
##                                          1
##                  g__Candidatus Planktophila
##                                          1
##                      g__Candidatus Profftia
##                                          1
##                 g__Candidatus Promineifilum
```

```
##                                    1
##        g__Candidatus Pseudothioglobus
##                                    1
##               g__Candidatus Reidiella
##                                    1
##                  g__Candidatus Riesia
##                                    1
##           g__Candidatus Saccharimonas
##                                    1
##        g__Candidatus Sulfidibacterium
##                                    1
##            g__Candidatus Symbiobacter
##                                    1
##         g__Candidatus Syntrophocurvum
##                                    1
##             g__Candidatus Tachikawaea
##                                    1
##                g__Candidatus Vallotia
##                                    1
##          g__Candidatus Velamenicoccus
##                                    1
##            g__Candidatus Viadribacter
##                                    1
##            g__Candidatus Walczuchella
##                                    1
##       g__Candidatus Xiphinematobacter
##                                    1
##                 g__Capillimicrobium
##                                    1
##                   g__Caproicibacter
##                                    1
##                g__Caproiciproducens
##                                    1
##                   g__Carboxydocella
##                                    1
##                 g__Carboxydothermus
##                                    1
##                    g__Casimicrobium
##                                    1
##                   g__Castellaniella
##                                    1
##                   g__Catellatospora
##                                    1
##                    g__Catenulispora
##                                    1
##                      g__Caulifigura
##                                    1
##               g__Celerinatantimonas
##                                    1
##                    g__Cetobacterium
##                                    1
##                     g__Chamaesiphon
##                                    1
##                 g__Changpingibacter
```

```
##                                       1
##                                g__Chania
##                                       1
##                         g__Chelativorans
##                                       1
##                    g__Chenggangzhangella
##                                       1
##                         g__Chitinibacter
##                                       1
##                         g__Chitiniphilus
##                                       1
##                    g__Chitinolyticbacter
##                                       1
##                        g__Chloroherpeton
##                                       1
##                         g__Chondrocystis
##                                       1
##                          g__Chondromyces
##                                       1
##                          g__Chordicoccus
##                                       1
##                      g__Christensenella
##                                       1
##                     g__Chromohalobacter
##                                       1
##                   g__Chroococcidiopsis
##                                       1
##                          g__Chryseolinea
##                                       1
##                          g__Chthonomonas
##                                       1
##                          g__Ciceribacter
##                                       1
##                        g__Citromicrobium
##                                       1
##                        g__Cloacibacillus
##                                       1
##                            g__Cnuibacter
##                                       1
##                         g__Cognatishimia
##                                       1
##                         g__Cohaesibacter
##                                       1
##                      g__Conchiformibius
##                                       1
##                        g__Congregibacter
##                                       1
##                     g__Constantimarinum
##                                       1
##                           g__Coprobacter
##                                       1
##                    g__Coprothermobacter
##                                       1
##                     g__Coraliomargarita
```

```
##                                           1
##                             g__Coriobacterium
##                                           1
##                              g__Couchioplanes
##                                           1
##                               g__Crateriforma
##                                           1
##                                g__Crenobacter
##                                           1
##                                  g__Crinalium
##                                           1
##                            g__Croceibacterium
##                                           1
##                                 g__Crossiella
##                                           1
##                               g__Cruoricaptor
##                                           1
##                                g__Curvibacter
##                                           1
##                             g__Cyanobacterium
##                                           1
##                              g__Cyclonatronum
##                                           1
##                                g__Cystobacter
##                                           1
##                           g__Dactylococcopsis
##                                           1
##                              g__Deferribacter
##                                           1
##                               g__Defluviitoga
##                                           1
##                            g__Dehalobacterium
##                                           1
##                                  g__Demequina
##                                           1
##                           g__Denitrificimonas
##                                           1
##                           g__Denitrobacterium
##                                           1
##                              g__Denitrovibrio
##                                           1
##                                   g__Desemzia
##                                           1
##                              g__Desulfarculus
##                                           1
##                          g__Desulfatibacillum
##                                           1
##                               g__Desulfobacca
##                                           1
##                              g__Desulfobacula
##                                           1
##                               g__Desulfocapsa
##                                           1
##                              g__Desulfococcus
```

```
##                                                 1
##                            g__Desulfocurvibacter
##                                                 1
##                               g__Desulfofarcimen
##                                                 1
##                                 g__Desulfoglaeba
##                                                 1
##                               g__Desulfohalobium
##                                                 1
##                            g__Desulfolithobacter
##                                                 1
##                                   g__Desulfoluna
##                                                 1
##                             g__Desulfolutivibrio
##                                                 1
##                                 g__Desulfomarina
##                                                 1
##                                 g__Desulfomonile
##                                                 1
##                                g__Desulforapulum
##                                                 1
##                                 g__Desulfoscipio
##                                                 1
##                           g__Desulfosediminicola
##                                                 1
##                                  g__Desulfosudis
##                                                 1
##                                  g__Desulfotalea
##                                                 1
##                              g__Desulfotomaculum
##                                                 1
##                            g__Desulfurispirillum
##                                                 1
##                               g__Desulfurivibrio
##                                                 1
##                                     g__Devriesea
##                                                 1
##                                 g__Dichelobacter
##                                                 1
##                               g__Dinoroseobacter
##                                                 1
##                          g__Dissulfurimicrobium
##                                                 1
##                              g__Dissulfurispira
##                                                 1
##                                    g__Dokdonella
##                                                 1
##                                g__Dolichospermum
##                                                 1
##                                g__Dolosigranulum
##                                                 1
##                                     g__Dongshaea
##                                                 1
##                                     g__Duganella
```

```
##                                                      1
##                                      g__Duodenibacillus
##                                                      1
##                                        g__Dysosmobacter
##                                                      1
##                                   g__Ectothiorhodosinus
##                                                      1
##                                       g__Effusibacillus
##                                                      1
##                                            g__Egibacter
##                                                      1
##                                            g__Egicoccus
##                                                      1
##                                             g__Elioraea
##                                                      1
##                                       g__Elusimicrobium
##                                                      1
##                                           g__Emergencia
##                                                      1
##                                         g__Entomobacter
##                                                      1
##                                    g__Ephemeroptericola
##                                                      1
##                                  g__Epidermidibacterium
##                                                      1
##                                      g__Epilithonimonas
##                                                      1
##                                          g__Ereboglobus
##                                                      1
##                                       g__Ethanoligenens
##                                                      1
##                                          g__Euhalothece
##                                                      1
##                                              g__Euzebya
##                                                      1
##                                            g__Ewingella
##                                                      1
##                                      g__Faecalibacillus
##                                                      1
##                                       g__Faecalibaculum
##                                                      1
##                                         g__Faecalitalea
##                                                      1
##                               g__Falsihalocynthiibacter
##                                                      1
##                                     g__Falsirhodobacter
##                                                      1
##                                          g__Fannyhessea
##                                                      1
##                                       g__Fastidiosipila
##                                                      1
##                                           g__Fenollaria
##                                                      1
##                                       g__Ferribacterium
```

```
##                                            1
##                                g__Ferrigenium
##                                            1
##                              g__Ferriphaselus
##                                            1
##                                g__Ferrovibrio
##                                            1
##                                   g__Ferrovum
##                                            1
##                            g__Ferruginibacter
##                                            1
##                                   g__Fibrella
##                                            1
##                                g__Fibrobacter
##                                            1
##                                 g__Filifactor
##                                            1
##                                  g__Filimonas
##                                            1
##                              g__Filomicrobium
##                                            1
##                               g__Fimbriimonas
##                                            1
##                                 g__Finegoldia
##                                            1
##                            g__Flagellatimonas
##                                            1
##                            g__Flavihumibacter
##                                            1
##                                 g__Flavivirga
##                                            1
##                             g__Flavonifractor
##                                            1
##                                g__Flexistipes
##                                            1
##                               g__Flintibacter
##                                            1
##                               g__Fluoribacter
##                                            1
##                               g__Fontisphaera
##                                            1
##                               g__Formicincola
##                                            1
##                              g__Frederiksenia
##                                            1
##                             g__Fretibacterium
##                                            1
##                             g__Friedmanniella
##                                            1
##                              g__Frigidibacter
##                                            1
##                              g__Frigoriglobus
##                                            1
##                                g__Fuerstiella
```

```
##                                      1
##                  g__Furfurilactobacillus
##                                      1
##                           g__Galbibacter
##                                      1
##                         g__Gallaecimonas
##                                      1
##                        g__Gallibacterium
##                                      1
##                         g__Geitlerinema
##                                      1
##                                g__Gelria
##                                      1
##                         g__Geminocystis
##                                      1
##                          g__Gemmatirosa
##                                      1
##                      g__Geodermatophilus
##                                      1
##                         g__Georhizobium
##                                      1
##                       g__Geosporobacter
##                                      1
##                             g__Geovibrio
##                                      1
##                      g__Gephyromycinifex
##                                      1
##                           g__Gibbsiella
##                                      1
##                          g__Gilvibacter
##                                      1
##                         g__Gilvimarinus
##                                      1
##                           g__Glaciecola
##                                      1
##                       g__Glaciihabitans
##                                      1
##                          g__Glaciimonas
##                                      1
##                       g__Gloeomargarita
##                                      1
##                           g__Gloeothece
##                                      1
##                     g__Gluconacetobacter
##                                      1
##                          g__Glycocaulis
##                                      1
##                          g__Gottfriedia
##                                      1
##                         g__Gottschalkia
##                                      1
##                          g__Gracilinema
##                                      1
##                        g__Granulibacter
```

```
##                                          1
##                                g__Grimontia
##                                          1
##                          g__Gryllotalpicola
##                                          1
##                               g__Gudongella
##                                          1
##                              g__Guyparkeria
##                                          1
##                        g__Gymnodinialimonas
##                                          1
##                                 g__Gynuella
##                                          1
##                           g__Haematobacter
##                                          1
##                       g__Haematospirillum
##                                          1
##                                  g__Hafnia
##                                          1
##                         g__Halalkalibacter
##                                          1
## g__Halalkalibacterium (ex Joshi et al. 2022)
##                                          1
##                           g__Halarcobacter
##                                          1
##                              g__Haliangium
##                                          1
##                       g__Haliscomenobacter
##                                          1
##                        g__Halobacteroides
##                                          1
##                          g__Halomicronema
##                                          1
##                         g__Halorhodospira
##                                          1
##                               g__Halotalea
##                                          1
##                               g__Halothece
##                                          1
##                        g__Halothermothrix
##                                          1
##                                 g__Halotia
##                                          1
##                             g__Haploplasma
##                                          1
##                        g__Hartmannibacter
##                                          1
##                               g__Hathewaya
##                                          1
##                             g__Helcococcus
##                                          1
##                          g__Heliomicrobium
##                                          1
##                             g__Heliorestis
```

```
##                                         1
##                               g__Herbinix
##                                         1
##                                 g__Hippea
##                                         1
##                               g__Hirschia
##                                         1
##                                g__Hoeflea
##                                         1
##                       g__Homoserinibacter
##                                         1
##                            g__Horticoccus
##                                         1
##                             g__Humibacter
##                                         1
##                            g__Humisphaera
##                                         1
##                   g__Hydrocarboniclastica
##                                         1
##                      g__Hydrogenibacillus
##                                         1
##                         g__Hydrogenimonas
##                                         1
##                        g__Hydrogenophilus
##                                         1
##                        g__Hydrogenovibrio
##                                         1
##                            g__Hylemonella
##                                         1
##                         g__Hyphobacterium
##                                         1
##                            g__Hyphococcus
##                                         1
##                       g__Ichthyobacterium
##                                         1
##                              g__Ideonella
##                                         1
##                          g__Ilumatobacter
##                                         1
##                             g__Ilyobacter
##                                         1
##                      g__Immundisolibacter
##                                         1
##                        g__Indioceanicola
##                                         1
##                                g__Inhella
##                                         1
##                       g__Intestinibaculum
##                                         1
##                        g__Intestinimonas
##                                         1
##                       g__Intrasporangium
##                                         1
##                             g__Iodobacter
```

```
##                                      1
##                      g__Isoalcanivorax
##                                      1
##                          g__Isosphaera
##                                      1
##                          g__Jejubacter
##                                      1
##                    g__Jeotgalibacillus
##                                      1
##                              g__Jiella
##                                      1
##                             g__Jonesia
##                                      1
##                         g__Jonquetella
##                                      1
##                           g__Kaistella
##                                      1
##                             g__Kaistia
##                                      1
##                          g__Kalamiella
##                                      1
##                             g__Kaustia
##                                      1
##                     g__Keratinibaculum
##                                      1
##                          g__Ketobacter
##                                      1
##                  g__Ketogulonicigenium
##                                      1
##                   g__Kibdelosporangium
##                                      1
##                        g__Kineobactrum
##                                      1
##                         g__Kineococcus
##                                      1
##                     g__Kiritimatiella
##                                      1
##                           g__Koinonema
##                                      1
##                         g__Koleobacter
##                                      1
##                         g__Kordiimonas
##                                      1
##                           g__Kovacikia
##                                      1
##                             g__Kozakia
##                                      1
##                  g__Ktedonosporobacter
##                                      1
##                          g__Kytococcus
##                                      1
##                         g__Labilithrix
##                                      1
##                              g__Labrys
```

```
##                                              1
##                                    g__Laceyella
##                                              1
##                                  g__Lachnospira
##                                              1
##                                   g__Lacibacter
##                                              1
##                                g__Lacimicrobium
##                                              1
##                                   g__Lacinutrix
##                                              1
##                                g__Lacipirellula
##                                              1
##                                g__Lacunisphaera
##                                              1
##                          g__Lapidilactobacillus
##                                              1
##                                   g__Laribacter
##                                              1
##                                   g__Larkinella
##                                              1
##                                    g__Lautropia
##                                              1
##                                   g__Lawsonella
##                                              1
##                                     g__Lawsonia
##                                              1
##                                  g__Leadbettera
##                                              1
##                               g__Leadbetterella
##                                              1
##                                  g__Leminorella
##                                              1
##                            g__Lentilitoribacter
##                                              1
##                                 g__Lentisphaera
##                                              1
##                                  g__Leptodesmis
##                                              1
##                            g__Leptogranulimonas
##                                              1
##                               g__Leptospirillum
##                                              1
##                                   g__Leptothrix
##                                              1
##                                  g__Lichenicola
##                                              1
##                               g__Lignipirellula
##                                              1
##                               g__Limihaloglobus
##                                              1
##                                  g__Limnobacter
##                                              1
##                                 g__Limnobaculum
```

```
##                                                    1
##                                         g__Limnochorda
##                                                    1
##                                         g__Limnoglobus
##                                                    1
##                                          g__Loktanella
##                                                    1
##                                         g__Longicatena
##                                                    1
##                                           g__Lonsdalea
##                                                    1
##                                      g__Luteimicrobium
##                                                    1
##                                    g__Luteipulveratus
##                                                    1
##                                  g__Luteithermobacter
##                                                    1
##                                      g__Mageeibacillus
##                                                    1
##                                       g__Magnetococcus
##                                                    1
##                                        g__Magnetospira
##                                                    1
##                                             g__Mahella
##                                                    1
##                                      g__Maioricimonas
##                                                    1
##                                      g__Maliibacterium
##                                                    1
##                                          g__Mameliella
##                                                    1
##                                          g__Maribellus
##                                                    1
##                                            g__Maribius
##                                                    1
##                                          g__Maricaulis
##                                                    1
##                                      g__Marichromatium
##                                                    1
##                                       g__Mariniblastus
##                                                    1
##                                         g__Marinicauda
##                                                    1
##                                       g__Mariniflexile
##                                                    1
##                                g__Marinilactibacillus
##                                                    1
##                                  g__Marinilongibacter
##                                                    1
##                                    g__Marinimicrobium
##                                                    1
##                                        g__Mariniplasma
##                                                    1
##                                       g__Marinithermus
```

```
##                                              1
##                                   g__Marinitoga
##                                              1
##                             g__Marisediminicola
##                                              1
##                                    g__Maritalea
##                                              1
##                                    g__Marivirga
##                                              1
##                                  g__Marmoricola
##                                              1
##                               g__Marvinbryantia
##                                              1
##                              g__Massilistercora
##                                              1
##                          g__Megalodesulfovibrio
##                                              1
##                                g__Melissococcus
##                                              1
##                                 g__Melittangium
##                                              1
##                                  g__Mergibacter
##                                              1
##                              g__Mesoflavibacter
##                                              1
##                                     g__Mesotoga
##                                              1
##                              g__Methylobacillus
##                                              1
##                                g__Methylobacter
##                                              1
##                                g__Methylocaldum
##                                              1
##                                 g__Methylocella
##                                              1
##                                  g__Methylogaea
##                                              1
##                               g__Methyloligella
##                                              1
##                                g__Methylomagnum
##                                              1
##                             g__Methylomicrobium
##                                              1
##                                  g__Methylomusa
##                                              1
##                                 g__Methylophaga
##                                              1
##                            g__Methyloversatilis
##                                              1
##                               g__Methylovirgula
##                                              1
##                                 g__Methylovulum
##                                              1
##                                   g__Micavibrio
```

```
##                                           1
##                                g__Microbacter
##                                           1
##                                g__Micropruina
##                                           1
##                             g__Microterricola
##                                           1
##                               g__Microvenator
##                                           1
##                               g__Microvirgula
##                                           1
##                                 g__Miniimonas
##                                           1
##                          g__Miniphocaeibacter
##                                           1
##                                 g__Monoglobus
##                                           1
##                                    g__Moorena
##                                           1
##                                 g__Morganella
##                                           1
##                                 g__Morococcus
##                                           1
##                                g__Mucisphaera
##                                           1
##                              g__Mucispirillum
##                                           1
##                                      g__Mumia
##                                           1
##                               g__Murdochiella
##                                           1
##                                   g__Musicola
##                                           1
##                                 g__Nanchangia
##                                           1
##                                g__Nannocystis
##                                           1
##                             g__Natranaerobius
##                                           1
##                             g__Natranaerofaba
##                                           1
##                          g__Natronoglycomyces
##                                           1
##                          g__Natronosporangium
##                                           1
##                                   g__Nautilia
##                                           1
##                               g__Ndongobacter
##                                           1
##                                   g__Neoasaia
##                                           1
##                               g__Neochlamydia
##                                           1
##                             g__Neotabrizicola
```

```
##                                       1
##                          g__Neptunomonas
##                                       1
##                              g__Niabella
##                                       1
##                             g__Niastella
##                                       1
##                           g__Nibribacter
##                                       1
##                           g__Nibricoccus
##                                       1
##                                g__Nisaea
##                                       1
##                           g__Nissabacter
##                                       1
##                        g__Nitratifractor
##                                       1
##                         g__Nitratiruptor
##                                       1
##                            g__Nitrincola
##                                       1
##                            g__Nitrospina
##                                       1
##                        g__Nitrospirillum
##                                       1
##                        g__Niveibacterium
##                                       1
##                        g__Niveispirillum
##                                       1
##                              g__Nordella
##                                       1
##                       g__Nosocomiicoccus
##                                       1
##                          g__Novibacillus
##                                       1
##                    g__Noviherbaspirillum
##                                       1
##                   g__Novisyntrophococcus
##                                       1
##                      g__Novosphingopyxis
##                                       1
##                       g__Obesumbacterium
##                                       1
##                       g__Occallatibacter
##                                       1
##                            g__Occultella
##                                       1
##                          g__Oceanicoccus
##                                       1
##                            g__Oceanicola
##                                       1
##                   g__Oceanidesulfovibrio
##                                       1
##                           g__Oceanimonas
```

```
##                                                   1
##                                     g__Oceanirhabdus
##                                                   1
##                                 g__Oceanispirochaeta
##                                                   1
##                                     g__Oceanithermus
##                                                   1
##                                        g__Oceanotoga
##                                                   1
##                                       g__Odoribacter
##                                                   1
##                                         g__Oerskovia
##                                                   1
##                                 g__Oleidesulfovibrio
##                                                   1
##                                        g__Oleiphilus
##                                                   1
##                                           g__Oricola
##                                                   1
##                                          g__Orientia
##                                                   1
##                                   g__Ornithobacterium
##                                                   1
##                                     g__Oryzomicrobium
##                                                   1
##                                     g__Oscillibacter
##                                                   1
##                                       g__Owenweeksia
##                                                   1
##                                           g__Oxynema
##                                                   1
##                                     g__Pacificitalea
##                                                   1
##                                    g__Paenalcaligenes
##                                                   1
##                                   g__Paenalkalicoccus
##                                                   1
##                                   g__Paeniclostridium
##                                                   1
##                                 g__Paenisporosarcina
##                                                   1
##                                   g__Pajaroellobacter
##                                                   1
##                                      g__Paludibacter
##                                                   1
##                                     g__Paludibaculum
##                                                   1
##                                     g__Paludisphaera
##                                                   1
##                                     g__Pannonibacter
##                                                   1
##                                    g__Paracholeplasma
##                                                   1
##                                    g__Paraclostridium
```

```
##                                        1
##                       g__Paraconexibacter
##                                        1
##  g__Paradesulfovibrio (ex Waite et al. 2020)
##                                        1
##                            g__Paradevosia
##                                        1
##                        g__Parafannyhessea
##                                        1
##                         g__Paraflavitalea
##                                        1
##                         g__Paralcaligenes
##                                        1
##                        g__Paraliobacillus
##                                        1
##                           g__Paralysiella
##                                        1
##                       g__Paraneptunicella
##                                        1
##                          g__Paraoerskovia
##                                        1
##                     g__Paraphotobacterium
##                                        1
##                     g__Pararhodospirillum
##                                        1
##                     g__Parasaccharibacter
##                                        1
##                          g__Parascardovia
##                                        1
##                     g__Parasedimentitalea
##                                        1
##                     g__Parasphingorhabdus
##                                        1
##                    g__Paraurantiacibacter
##                                        1
##                            g__Parazoarcus
##                                        1
##                          g__Paremcibacter
##                                        1
##                         g__Paroceanicella
##                                        1
##                           g__Parvibaculum
##                                        1
##                             g__Parvicella
##                                        1
##                             g__Parvimonas
##                                        1
##                            g__Pasteurella
##                                        1
##                            g__Paucibacter
##                                        1
##                           g__Pauljensenia
##                                        1
##                             g__Pectinatus
```

```
##                                          1
##                                g__Pedococcus
##                                          1
##                        g__Pelagerythrobacter
##                                          1
##                                 g__Pelagovum
##                                          1
##                                g__Pelobacter
##                                          1
##                                 g__Pelolinea
##                                          1
##                          g__Pengzhenrongella
##                                          1
##                           g__Peptacetobacter
##                                          1
##                          g__Peptoclostridium
##                                          1
##                        g__Peptostreptococcus
##                                          1
##                             g__Periweissella
##                                          1
##                            g__Permianibacter
##                                          1
##                             g__Persephonella
##                                          1
##                              g__Persicimonas
##                                          1
##                             g__Persicobacter
##                                          1
##                            g__Peterkaempfera
##                                          1
##                              g__Peteryoungia
##                                          1
##                                g__Petrimonas
##                                          1
##                                g__Petrocella
##                                          1
##                          g__Petroclostridium
##                                          1
##                                 g__Petrotoga
##                                          1
##                            g__Phoenicibacter
##                                          1
##                                g__Phormidium
##                                          1
##                              g__Photorhabdus
##                                          1
##                            g__Phototrophicus
##                                          1
##                              g__Phycisphaera
##                                          1
##                               g__Phytobacter
##                                          1
##                            g__Pigmentibacter
```

```
##                                              1
##                                g__Pigmentiphaga
##                                              1
##                                 g__Pikeienuella
##                                              1
##                                 g__Pimelobacter
##                                              1
##                                    g__Pirellula
##                                              1
##                              g__Pirellulimonas
##                                              1
##                                g__Piscinibacter
##                                              1
##                              g__Piscirickettsia
##                                              1
##                                 g__Pistricoccus
##                                              1
##                                 g__Planctopirus
##                                              1
##                                 g__Planktothrix
##                                              1
##                                  g__Plesiomonas
##                                              1
##                                  g__Pleurocapsa
##                                              1
##                                   g__Polyangium
##                                              1
##                               g__Polycladomyces
##                                              1
##                                  g__Polymorphum
##                                              1
##                               g__Polystyrenella
##                                              1
##                             g__Pontibrevibacter
##                                              1
##                                  g__Ponticoccus
##                                              1
##                                   g__Pontimonas
##                                              1
##                                  g__Pontivivens
##                                              1
##                              g__Poriferisphaera
##                                              1
##                                    g__Pradoshia
##                                              1
##                                       g__Pragia
##                                              1
##                                  g__Prauserella
##                                              1
##                                 g__Prescottella
##                                              1
##                               g__Profundibacter
##                                              1
##                            g__Proteiniclasticum
```

```
##                                              1
##                               g__Proteiniphilum
##                                              1
##                                 g__Protofrankia
##                                              1
##                             g__Pseudactinotalea
##                                              1
##                          g__Pseudalkalibacillus
##                                              1
##                                g__Pseudazoarcus
##                                              1
##                             g__Pseudescherichia
##                                              1
##                                 g__Pseudobacter
##                                              1
##                           g__Pseudobdellovibrio
##                                              1
##                           g__Pseudobutyrivibrio
##                                              1
##                            g__Pseudocitrobacter
##                                              1
##                            g__Pseudoclavibacter
##                                              1
##                            g__Pseudoclostridium
##                                              1
##                                g__Pseudocnuella
##                                              1
##                                g__Pseudofrankia
##                                              1
##                           g__Pseudogulbenkiania
##                                              1
##                      g__Pseudohalocynthiibacter
##                                              1
##                              g__Pseudohongiella
##                                              1
##                             g__Pseudolysobacter
##                                              1
##                             g__Pseudopedobacter
##                                              1
##                             g__Pseudoprevotella
##                                              1
##                       g__Pseudopuniceibacterium
##                                              1
##                            g__Pseudorhodobacter
##                                              1
##                            g__Pseudorhodoplanes
##                                              1
##                                g__Pseudothauera
##                                              1
##                                 g__Pseudovibrio
##                                              1
##                                g__Psychroflexus
##                                              1
##                             g__Psychromicrobium
```

```
##                                          1
##                              g__Psychromonas
##                                          1
##                                 g__Pukyongia
##                                          1
##                              g__Pukyongiella
##                                          1
##                         g__Pullulanibacillus
##                                          1
##                             g__Pulveribacter
##                                          1
##                             g__Pusillibacter
##                                          1
##                            g__Pyramidobacter
##                                          1
##                            g__Pyruvatibacter
##                                          1
##                              g__Pyxidicoccus
##                                          1
##                                    g__Qiania
##                                          1
##                         g__Qingshengfaniella
##                                          1
##                           g__Quatrionicoccus
##                                          1
##                                g__Raineyella
##                                          1
##                               g__Ramlibacter
##                                          1
##                             g__Raoultibacter
##                                          1
##                          g__Reichenbachiella
##                                          1
##                                  g__Reinekea
##                                          1
##                                g__Rhodobaca
##                                          1
##                         g__Rhodocaloribacter
##                                          1
##                            g__Rhodomicrobium
##                                          1
##                            g__Rhodopirellula
##                                          1
##                               g__Rhodoplanes
##                                          1
##                              g__Rhodothermus
##                                          1
##                               g__Rhodovastum
##                                          1
##                                  g__Rippkaea
##                                          1
##                                 g__Rivularia
##                                          1
##                             g__Robiginitalea
```

```
##                                        1
##                          g__Rodentibacter
##                                        1
##                         g__Roseibacterium
##                                        1
##                           g__Roseicitreum
##                                        1
##                          g__Roseimaritima
##                                        1
##                         g__Roseimicrobium
##                                        1
##                             g__Roseitalea
##                                        1
##                            g__Roseococcus
##                                        1
##                             g__Rosistilla
##                                        1
##                          g__Rubinisphaera
##                                        1
##                         g__Rubripirellula
##                                        1
##                             g__Rubrivivax
##                                        1
##                             g__Ruficoccus
##                                        1
##                              g__Rugamonas
##                                        1
##                           g__Rugosibacter
##                                        1
##                       g__Ruthenibacterium
##                                        1
##                       g__Saccharibacillus
##                                        1
##                         g__Saccharophagus
##                                        1
##                      g__Saccharospirillum
##                                        1
##                              g__Sagittula
##                                        1
##                           g__Salaquimonas
##                                        1
##                        g__Salegentibacter
##                                        1
##                      g__Salidesulfovibrio
##                                        1
##                          g__Salimicrobium
##                                        1
##                           g__Salinibacter
##                                        1
##                        g__Salinimicrobium
##                                        1
##                           g__Saliniradius
##                                        1
##                          g__Salinisphaera
```

```
##                                          1
##                                g__Salinispira
##                                          1
##                                g__Salinispora
##                                          1
##                               g__Salinivibrio
##                                          1
##                                g__Salinivirga
##                                          1
##                          g__Salipaludibacillus
##                                          1
##                       g__Sandaracinobacteroides
##                                          1
##                               g__Sandaracinus
##                                          1
##                                 g__Saprospira
##                                          1
##                                    g__Sarcina
##                                          1
##                               g__Scandinavium
##                                          1
##                                  g__Scardovia
##                                          1
##                     g__Schleiferilactobacillus
##                                          1
##                                 g__Schnuerera
##                                          1
##                                  g__Scytonema
##                                          1
##                                 g__Sebaldella
##                                          1
##                           g__Sedimentibacter
##                                          1
##                             g__Sedimenticola
##                                          1
##                          g__Sediminibacillus
##                                          1
##                            g__Sediminicoccus
##                                          1
##                               g__Sediminicola
##                                          1
##                       g__Sediminispirochaeta
##                                          1
##                               g__Segniliparus
##                                          1
##                                 g__Sellimonas
##                                          1
##                          g__Serpentinicella
##                                          1
##                                 g__Shimwellia
##                                          1
##                                g__Siccibacter
##                                          1
##                             g__Sideroxyarcus
```

```
##                                            1
##                                g__Silicimonas
##                                            1
##                              g__Silvanigrella
##                                            1
##                                    g__Simiaoa
##                                            1
##                              g__Siminovitchia
##                                            1
##                                   g__Simkania
##                                            1
##                                g__Simonsiella
##                                            1
##                              g__Simplicispira
##                                            1
##                             g__Singulisphaera
##                                            1
##                        g__Sinimarinibacterium
##                                            1
##                              g__Sinomicrobium
##                                            1
##                                  g__Skermania
##                                            1
##                                    g__Slackia
##                                            1
##                                   g__Sneathia
##                                            1
##                                g__Sneathiella
##                                            1
##                               g__Sodaliphilus
##                                            1
##                                g__Solibaculum
##                                            1
##                                   g__Solicola
##                                            1
##                                  g__Solimonas
##                                            1
##                                  g__Solitalea
##                                            1
##                            g__Spartinivicinus
##                                            1
##                          g__Sphaerisporangium
##                                            1
##                              g__Sphaerobacter
##                                            1
##                  g__Sphingosinithalassobacter
##                                            1
##                            g__Spiractinospora
##                                            1
##                              g__Spongiibacter
##                                            1
##                               g__Sporofaciens
##                                            1
##                         g__Sporolactobacillus
```

```
##                                         1
##                               g__Sporomusa
##                                         1
##                          g__Stackebrandtia
##                                         1
##                               g__Stanieria
##                                         1
##                           g__Staphylospora
##                                         1
##                                  g__Stella
##                                         1
##                          g__Steroidobacter
##                                         1
##                        g__Sterolibacterium
##                                         1
##                             g__Stigmatella
##                                         1
##                      g__Streptantibioticus
##                                         1
##                         g__Streptobacillus
##                                         1
##                         g__Subdoligranulum
##                                         1
##                              g__Subtercola
##                                         1
##                           g__Succinivibrio
##                                         1
##                               g__Suicoccus
##                                         1
##                           g__Sulfidibacter
##                                         1
##                           g__Sulfuricaulis
##                                         1
##                            g__Sulfuricella
##                                         1
##                           g__Sulfuriflexus
##                                         1
##                           g__Sulfurifustis
##                                         1
##                        g__Sulfurimicrobium
##                                         1
##                      g__Sulfuriroseicoccus
##                                         1
##                            g__Sulfuritalea
##                                         1
##                           g__Sulfuritortus
##                                         1
##                           g__Sulfurivermis
##                                         1
##                       g__Superficieibacter
##                                         1
##                              g__Suttonella
##                                         1
##                         g__Symbiobacterium
```

```
##                                                1
##                         g__Symbiopectobacterium
##                                                1
##                                 g__Symmachiella
##                                                1
##                              g__Syntrophobacter
##                                                1
##                             g__Syntrophobotulus
##                                                1
##                               g__Syntrophomonas
##                                                1
##                             g__Syntrophothermus
##                                                1
##                                   g__Syntrophus
##                                                1
##                                  g__Tabrizicola
##                                                1
##                                   g__Tahibacter
##                                                1
##                                  g__Tannockella
##                                                1
##                                  g__Tardibacter
##                                                1
##                                    g__Tatumella
##                                                1
##                                     g__Tautonia
##                                                1
##                                   g__Taylorella
##                                                1
##                              g__Tellurirhabdus
##                                                1
##                                  g__Telmatocola
##                                                1
##                           g__Tepidanaerobacter
##                                                1
##                                  g__Tepidimonas
##                                                1
##                                   g__Tepiditoga
##                                                1
##                              g__Teredinibacter
##                                                1
##                                 g__Terricaulis
##                                                1
##                               g__Terrihabitans
##                                                1
##                            g__Terrisporobacter
##                                                1
##                                g__Tetrasphaera
##                                                1
##                              g__Thalassobacter
##                                                1
##                                g__Thalassobius
##                                                1
##                              g__Thalassococcus
```

```
##                                           1
##                           g__Thaumasiovibrio
##                                           1
##                          g__Thermacetogenium
##                                           1
##                          g__Thermanaeromonas
##                                           1
##                       g__Thermanaerosceptrum
##                                           1
##                               g__Thermincola
##                                           1
##                         g__Thermoactinomyces
##                                           1
##                            g__Thermobacillus
##                                           1
##                             g__Thermobaculum
##                                           1
##                             g__Thermobispora
##                                           1
##                      g__Thermocaproicibacter
##                                           1
##                          g__Thermochromatium
##                                           1
##                         g__Thermoclostridium
##                                           1
##                         g__Thermodesulfobium
##                                           1
##                    g__Thermodesulfomicrobium
##                                           1
##                       g__Thermodesulfovibrio
##                                           1
##                               g__Thermogutta
##                                           1
##                           g__Thermoleophilum
##                                           1
##                           g__Thermomicrobium
##                                           1
##                         g__Thermophilibacter
##                                           1
##                      g__Thermosediminibacter
##                                           1
##                               g__Thermosipho
##                                           1
##                             g__Thermostichus
##                                           1
##                        g__Thermosulfurimonas
##                                           1
##                       g__Thermosulfuriphilus
##                                           1
##                           g__Thermotomaculum
##                                           1
##                              g__Thermovibrio
##                                           1
##                               g__Thermovirga
```

```
##                                          1
##                              g__Thiobacillus
##                                          1
##                                 g__Thiocapsa
##                                          1
##                                g__Thiocystis
##                                          1
##                               g__Thiodictyon
##                                          1
##                           g__Thioflavicoccus
##                                          1
##                              g__Thiolapillus
##                                          1
##                           g__Thiospirochaeta
##                                          1
##                         g__Thiosulfativibrio
##                                          1
##                              g__Tichowtungia
##                                          1
##                               g__Tissierella
##                                          1
##                                 g__Tistrella
##                                          1
##                                 g__Tolumonas
##                                          1
##                           g__Trichlorobacter
##                                          1
##                        g__Trichothermofontia
##                                          1
##                             g__Tritonibacter
##                                          1
##                                  g__Truepera
##                                          1
##                               g__Turicimonas
##                                          1
##                               g__Turneriella
##                                          1
##                                g__Tuwongella
##                                          1
##                                g__Tyzzerella
##                                          1
##                             g__Undibacterium
##                                          1
##                             g__Urbifossiella
##                                          1
##                           g__Vaginimicrobium
##                                          1
##                               g__Variibacter
##                                          1
##                             g__Varunaivibrio
##                                          1
##                            g__Venatoribacter
##                                          1
##                         g__Verminephrobacter
```

```
##                                                  1
##                                  g__Vulgatibacter
##                                                  1
##                                        g__Waddlia
##                                                  1
##                                        g__Wansuia
##                                                  1
##                                     g__Wielerella
##                                                  1
##                             g__Williamsoniiplasma
##                                                  1
##                                         g__Winkia
##                                                  1
##                                        g__Woeseia
##                                                  1
##                                      g__Wolbachia
##                                                  1
##                                      g__Wolinella
##                                                  1
##                                          g__Wujia
##                                                  1
##                                       g__Xiamenia
##                                                  1
##                                 g__Xianfuyuplasma
##                                                  1
##                                        g__Xylella
##                                                  1
##                                     g__Xylophilus
##                                                  1
##                                         g__Yangia
##                                                  1
##                                        g__Yimella
##                                                  1
##                                    g__Yinghuangia
##                                                  1
##                                      g__Yokenella
##                                                  1
##                                         g__Yoonia
##                                                  1
##                                     g__Youhaiella
##                                                  1
##                                      g__Zhaonella
##                                                  1
##                                    g__Zhongshania
##                                                  1
##                                     g__Zobellella
##                                                  1
##                                       g__Zobellia
##                                                  1
##                                      g__Zymomonas
##                                                  1
##                                    g__Acholeplasma
##                                                  2
##                               g__Acidiferrobacter
```

```
##                                              2
##                              g__Acidihalobacter
##                                              2
##                            g__Actinoalloteichus
##                                              2
##                            g__Actinocatenispora
##                                              2
##                                       g__Afipia
##                                              2
##                                 g__Algoriphagus
##                                              2
##                                 g__Aliamphritea
##                                              2
##                              g__Aliiroseovarius
##                                              2
##                                   g__Aliivibrio
##                                              2
##                              g__Alloalcanivorax
##                                              2
##                               g__Allochromatium
##                                              2
##                              g__Allofrancisella
##                                              2
##                                g__Aquabacterium
##                                              2
##                                     g__Aquibium
##                                              2
##                                 g__Aquihabitans
##                                              2
##                                     g__Aquirufa
##                                              2
##                                     g__Arachnia
##                                              2
##                                   g__Archangium
##                                              2
##                                 g__Arsenophonus
##                                              2
##                                g__Asticcacaulis
##                                              2
##                             g__Aurantimicrobium
##                                              2
##                               g__Auritidibacter
##                                              2
##                                 g__Bdellovibrio
##                                              2
##                                 g__Blastococcus
##                                              2
##                              g__Blattabacterium
##                                              2
##                          g__Bombilactobacillus
##                                              2
##                                     g__Borrelia
##                                              2
##                                  g__Borreliella
```

```
##                                               2
##                                    g__Caldimonas
##                                               2
##                     g__Candidatus Pelagibacter
##                                               2
##                               g__Cardiobacterium
##                                               2
##                                   g__Cereibacter
##                                               2
##                                 g__Chelatococcus
##                                               2
##                                  g__Chitinimonas
##                                               2
##                                  g__Chloroflexus
##                                               2
##                                g__Clostridioides
##                                               2
##                                      g__Cobetia
##                                               2
##                                    g__Colwellia
##                                               2
##                                      g__Deefgea
##                                               2
##                              g__Dehalococcoides
##                                               2
##                                g__Denitratisoma
##                                               2
##                                  g__Dermacoccus
##                                               2
##                                  g__Desulfonema
##                                               2
##                                 g__Dictyoglomus
##                                               2
##                                  g__Duncaniella
##                                               2
##                                    g__Ehrlichia
##                                               2
##                                    g__Eikenella
##                                               2
##                                g__Endomicrobium
##                                               2
##                                  g__Entomospira
##                                               2
##                                    g__Evansella
##                                               2
##                                   g__Ferrimonas
##                                               2
##                             g__Fervidibacillus
##                                               2
##                           g__Fervidobacterium
##                                               2
##                             g__Flavisolibacter
##                                               2
##                                    g__Frateuria
```

```
##                                              2
##                            g__Frigoribacterium
##                                              2
##                              g__Frondihabitans
##                                              2
##                                  g__Fuscovulum
##                                              2
##                                 g__Gemmobacter
##                                              2
##                                g__Glaesserella
##                                              2
##                                g__Gulosibacter
##                                              2
##                                     g__Hahella
##                                              2
##                               g__Halanaerobium
##                                              2
##                                 g__Halioglobus
##                                              2
##                           g__Halobacteriovorax
##                                              2
##                            g__Halothiobacillus
##                                              2
##                                 g__Herbiconiux
##                                              2
##                                g__Heyndrickxia
##                                              2
##                                  g__Hoylesella
##                                              2
##                                g__Isoptericola
##                                              2
##                                  g__Jeongeupia
##                                              2
##                                   g__Kangiella
##                                              2
##                                  g__Kinneretia
##                                              2
##                                   g__Kosmotoga
##                                              2
##                              g__Kroppenstedtia
##                                              2
##                                     g__Kurthia
##                                              2
##                                   g__Kushneria
##                                              2
##                              g__Lancefieldella
##                                              2
##                            g__Leeuwenhoekiella
##                                              2
##                                  g__Lelliottia
##                                              2
##                               g__Lentibacillus
##                                              2
##                                     g__Lentzea
```

```
##                                          2
##                           g__Lichenihabitans
##                                          2
##                               g__Lutibacter
##                                          2
##                                g__Megamonas
##                                          2
##                             g__Melaminivora
##                                          2
##                      g__Methylacidimicrobium
##                                          2
##                         g__Methylacidiphilum
##                                          2
##                              g__Methylibium
##                                          2
##                        g__Methyloceanibacter
##                                          2
##                             g__Methylophilus
##                                          2
##                              g__Methylosinus
##                                          2
##                             g__Methylotenera
##                                          2
##                      g__Methylotuvimicrobium
##                                          2
##                              g__Methylovorus
##                                          2
##                              g__Microcystis
##                                          2
##                                    g__Mixta
##                                          2
##                                g__Moritella
##                                          2
##                                 g__Myroides
##                                          2
##                             g__Nesterenkonia
##                                          2
##                              g__Nitrobacter
##                                          2
##                             g__Nitrosophilus
##                                          2
##                                g__Nonlabens
##                                          2
##                             g__Oceanisphaera
##                                          2
##                              g__Olivibacter
##                                          2
##                                   g__Olleya
##                                          2
##                                 g__Opitutus
##                                          2
##                                  g__Orrella
##                                          2
##                      g__Paeniglutamicibacter
```

```
##                                           2
##                            g__Paraglaciecola
##                                           2
##                             g__Pararhizobium
##                                           2
##                         g__Paucilactobacillus
##                                           2
##                           g__Pelagibacterium
##                                           2
##                               g__Pelodictyon
##                                           2
##                                 g__Pelosinus
##                                           2
##                               g__Phycicoccus
##                                           2
##                              g__Planctomyces
##                                           2
##                          g__Plantactinospora
##                                           2
##                             g__Pluralibacter
##                                           2
##                               g__Polaromonas
##                                           2
##                          g__Polymorphobacter
##                                           2
##                             g__Pontibacillus
##                                           2
##                           g__Prochlorococcus
##                                           2
##                           g__Propioniciclava
##                                           2
##                           g__Protaetiibacter
##                                           2
##                             g__Pseudanabaena
##                                           2
##                              g__Pseudolabrys
##                                           2
##                        g__Pseudosulfitobacter
##                                           2
##                          g__Pseudothermotoga
##                                           2
##                           g__Psychrobacillus
##                                           2
##                               g__Rhizobacter
##                                           2
##                                 g__Rhodoluna
##                                           2
##                            g__Rhodospirillum
##                                           2
##                                g__Roseivivax
##                                           2
##                               g__Roseobacter
##                                           2
##                          g__Rummeliibacillus
```

```
##                                  2
##                      g__Salinicoccus
##                                  2
##                       g__Salinimonas
##                                  2
##             g__Salisediminibacterium
##                                  2
##                      g__Sanguibacter
##                                  2
##                   g__Serpentinimonas
##                                  2
##                      g__Sideroxydans
##                                  2
##                          g__Simiduia
##                                  2
##                         g__Sinomonas
##                                  2
##                      g__Solibacillus
##                                  2
##                      g__Solwaraspora
##                                  2
##                         g__Sorangium
##                                  2
##                 g__Sphaerospermopsis
##                                  2
##                       g__Spirochaeta
##                                  2
##                          g__Starkeya
##                                  2
##                 g__Streptacidiphilus
##                                  2
##                  g__Streptomonospora
##                                  2
##                 g__Streptosporangium
##                                  2
##                     g__Sulfuriferula
##                                  2
##                     g__Sutcliffiella
##                                  2
##                           g__Tamlana
##                                  2
##                        g__Tannerella
##                                  2
##                       g__Tateyamaria
##                                  2
##                     g__Tenacibaculum
##                                  2
##                      g__Tepidibacter
##                                  2
##                     g__Terribacillus
##                                  2
##            g__Thermodesulfobacterium
##                                  2
##                        g__Thermotoga
```

```
##                                                   2
##                                        g__Ureaplasma
##                                                   2
##                                      g__Ureibacillus
##                                                   2
##                                       g__Uruburuella
##                                                   2
##                                     g__Usitatibacter
##                                                   2
##                                  g__Verrucomicrobium
##                                                   2
##                                      g__Vitreoscilla
##                                                   2
##                                         g__Vogesella
##                                                   2
##                                        g__Weizmannia
##                                                   2
##                                  g__Wenzhouxiangella
##                                                   2
##                                   g__Winogradskyella
##                                                   2
##                                      g__Zunongwangia
##                                                   2
##                                     g__Acaryochloris
##                                                   3
##                                   g__Acidaminococcus
##                                                   3
##                                     g__Actinosynnema
##                                                   3
##                                     g__Adlercreutzia
##                                                   3
##                                   g__Aggregatibacter
##                                                   3
##                                       g__Akkermansia
##                                                   3
##                                       g__Alcanivorax
##                                                   3
##                                       g__Allobaculum
##                                                   3
##                                       g__Aminobacter
##                                                   3
##                                  g__Aneurinibacillus
##                                                   3
##                                         g__Aquitalea
##                                                   3
##                                       g__Aromatoleum
##                                                   3
##                                          g__Baekduia
##                                                   3
##                                         g__Berryella
##                                                   3
##                                     g__Blastochloris
##                                                   3
##                                      g__Buttiauxella
```

```
##                                              3
##                                 g__Butyricimonas
##                                              3
##                                   g__Caloramator
##                                              3
##                         g__Candidatus Arthromitus
##                                              3
##                       g__Candidatus Nanosynbacter
##                                              3
##                         g__Candidatus Phytoplasma
##                                              3
##                               g__Catenibacterium
##                                              3
##                                       g__Cedecea
##                                              3
##                                  g__Cellulophaga
##                                              3
##                              g__Cellulosilyticum
##                                              3
##                                    g__Cellvibrio
##                                              3
##                                    g__Chlorobium
##                                              3
##                               g__Christiangramia
##                                              3
##                               g__Citrifermentans
##                                              3
##                               g__Cloacibacterium
##                                              3
##                                    g__Collimonas
##                                              3
##                                  g__Dehalobacter
##                                              3
##                               g__Dehalogenimonas
##                                              3
##                                   g__Dermabacter
##                                              3
##                                 g__Desulfobacter
##                                              3
##                                 g__Desulfobulbus
##                                              3
##                                         g__Dorea
##                                              3
##                              g__Draconibacterium
##                                              3
##                            g__Ectothiorhodospira
##                                              3
##                                  g__Edwardsiella
##                                              3
##                                  g__Empedobacter
##                                              3
##                                   g__Entomomonas
##                                              3
##                                     g__Ezakiella
```

```
##                                      3
##                           g__Flaviflexus
##                                      3
##                   g__Fructilactobacillus
##                                      3
##                           g__Gardnerella
##                                      3
##                               g__Gemmata
##                                      3
##                       g__Geoalkalibacter
##                                      3
##                              g__Geotalea
##                                      3
##                           g__Gilliamella
##                                      3
##                         g__Gluconobacter
##                                      3
##                         g__Gordonibacter
##                                      3
##                       g__Gracilibacillus
##                                      3
##                      g__Granulicatella
##                                      3
##                            g__Hungatella
##                                      3
##                        g__Hypericibacter
##                                      3
##                                 g__Iamia
##                                      3
##                     g__Jatrophihabitans
##                                      3
##                             g__Jiangella
##                                      3
##                              g__Kluyvera
##                                      3
##                             g__Kutzneria
##                                      3
##                              g__Kyrpidia
##                                      3
##                             g__Labrenzia
##                                      3
##                  g__Lachnoanaerobaculum
##                                      3
##                            g__Luteitalea
##                                      3
##                          g__Malacoplasma
##                                      3
##                            g__Maribacter
##                                      3
##                    g__Maridesulfovibrio
##                                      3
##                         g__Mariprofundus
##                                      3
##                            g__Martelella
```

```
##                                              3
##                                   g__Meiothermus
##                                              3
##                                  g__Mesobacillus
##                                              3
##                                g__Mesomycoplasma
##                                              3
##                                    g__Mesoplasma
##                                              3
##                                 g__Miltoncostaea
##                                              3
##                                    g__Mobiluncus
##                                              3
##                                 g__Modestobacter
##                                              3
##                                 g__Mogibacterium
##                                              3
##                                   g__Muribaculum
##                                              3
##                                    g__Mycetocola
##                                              3
##                              g__Mycolicibacillus
##                                              3
##                                g__Mycoplasmoides
##                                              3
##                               g__Nitratireductor
##                                              3
##                              g__Nitrogeniibacter
##                                              3
##                                 g__Nitrosococcus
##                                              3
##                                g__Octadecabacter
##                                              3
##                                       g__Ottowia
##                                              3
##                              g__Paenarthrobacter
##                                              3
##                               g__Paludibacterium
##                                              3
##                                g__Paraprevotella
##                                              3
##                                  g__Parolsenella
##                                              3
##                                 g__Phreatobacter
##                                              3
##                                 g__Phytohabitans
##                                              3
##                                g__Porphyrobacter
##                                              3
##                               g__Pseudorhizobium
##                                              3
##                                  g__Pusillimonas
##                                              3
##                                 g__Radiobacillus
```

```
##                                            3
##                               g__Rhizorhabdus
##                                            3
##                                g__Rhodobacter
##                                            3
##                                 g__Rhodovulum
##                                            3
##                                 g__Rickettsia
##                                            3
##                                 g__Roseateles
##                                            3
##                                  g__Roseibium
##                                            3
##                                g__Roseiflexus
##                                            3
##                              g__Rossellomorea
##                                            3
##                                 g__Rufibacter
##                                            3
##                                    g__Runella
##                                            3
##                              g__Saccharothrix
##                                            3
##                             g__Salicibibacter
##                                            3
##                                 g__Salinicola
##                                            3
##                       g__Secundilactobacillus
##                                            3
##                           g__Sedimentisphaera
##                                            3
##                               g__Sphaerotilus
##                                            3
##                           g__Sphingomicrobium
##                                            3
##                          g__Sphingosinicella
##                                            3
##                                    g__Stappia
##                                            3
##                                  g__Stieleria
##                                            3
##                           g__Sulfurospirillum
##                                            3
##                                 g__Sutterella
##                                            3
##                             g__Syntrophotalea
##                                            3
##                                   g__Telluria
##                                            3
##                                g__Tepidiforma
##                                            3
##                            g__Tetragenococcus
##                                            3
##                              g__Thalassomonas
```

```
##                                              3
##                         g__Thermanaerovibrio
##                                              3
##                              g__Thermocrinis
##                                              3
##                           g__Thermomonospora
##                                              3
##                            g__Thiohalobacter
##                                              3
##                                 g__Thiothrix
##                                              3
##                                 g__Tomitella
##                                              3
##                               g__Tsuneonella
##                                              3
##                              g__Tumebacillus
##                                              3
##                                g__Vallitalea
##                                              3
##                                g__Vescimonas
##                                              3
##                               g__Xenorhabdus
##                                              3
##                               g__Acetivibrio
##                                              4
##                            g__Acetobacterium
##                                              4
##                              g__Acidiphilium
##                                              4
##                    g__Acidipropionibacterium
##                                              4
##                               g__Alcaligenes
##                                              4
##                        g__Alkalihalobacillus
##                                              4
##                              g__Alkaliphilus
##                                              4
##                               g__Alteromonas
##                                              4
##                                 g__Aminipila
##                                              4
##                              g__Anaerostipes
##                                              4
##                          g__Apilactobacillus
##                                              4
##                            g__Arachidicoccus
##                                              4
##                                g__Arcobacter
##                                              4
##                          g__Aurantiacibacter
##                                              4
##                              g__Avibacterium
##                                              4
##                                  g__Azoarcus
```

```
##                                                  4
##                                      g__Azotobacter
##                                                  4
##                                        g__Brenneria
##                                                  4
##                                  g__Caproicibacterium
##                                                  4
##                                     g__Celeribacter
##                                                  4
##                                        g__Chlamydia
##                                                  4
##                                g__Chloracidobacterium
##                                                  4
##                                      g__Citricoccus
##                                                  4
##                                      g__Collinsella
##                                                  4
##                                  g__Crassaminicella
##                                                  4
##                                     g__Croceicoccus
##                                                  4
##                                        g__Cyanobium
##                                                  4
##                                    g__Dechloromonas
##                                                  4
##                                          g__Delftia
##                                                  4
##                                 g__Desulfomicrobium
##                                                  4
##                                   g__Desulforamulus
##                                                  4
##                                        g__Dialister
##                                                  4
##                                     g__Edaphobacter
##                                                  4
##                                      g__Eggerthella
##                                                  4
##                                          g__Ensifer
##                                                  4
##                                    g__Enterocloster
##                                                  4
##                                    g__Fictibacillus
##                                                  4
##                                     g__Gemmatimonas
##                                                  4
##                                      g__Gloeobacter
##                                                  4
##                                     g__Granulicella
##                                                  4
##                                      g__Haemophilus
##                                                  4
##                                   g__Hyphomicrobium
##                                                  4
##                                       g__Hyphomonas
```

```
##                                             4
##                                   g__Jannaschia
##                                             4
##                               g__Jeotgalicoccus
##                                             4
##                                    g__Kribbella
##                                             4
##                                 g__Lacrimispora
##                                             4
##                            g__Latilactobacillus
##                                             4
##                                    g__Leclercia
##                                             4
##                         g__Liquorilactobacillus
##                                             4
##                           g__Loigolactobacillus
##                                             4
##                                g__Luteolibacter
##                                             4
##                                g__Malaciobacter
##                                             4
##                              g__Marinobacterium
##                                             4
##                           g__Mediterraneibacter
##                                             4
##                               g__Metamycoplasma
##                                             4
##                                g__Methylorubrum
##                                             4
##                                   g__Microcella
##                                             4
##                                     g__Moorella
##                                             4
##                              g__Mycobacteroides
##                                             4
##                                  g__Nakamurella
##                                             4
##                                 g__Neorhizobium
##                                             4
##                                      g__Niallia
##                                             4
##                                 g__Nitrosomonas
##                                             4
##                                 g__Nitrosospira
##                                             4
##                                   g__Nitrospira
##                                             4
##                                   g__Oenococcus
##                                             4
##                                    g__Olsenella
##                                             4
##                                  g__Oxalobacter
##                                             4
##                        g__Phascolarctobacterium
```

```
##                                           4
##                          g__Phenylobacterium
##                                           4
##                           g__Phyllobacterium
##                                           4
##                              g__Plantibacter
##                                           4
##                         g__Propionibacterium
##                                           4
##                                   g__Proteus
##                                           4
##                         g__Pseudochrobactrum
##                                           4
##                          g__Pseudooceanicola
##                                           4
##                              g__Rheinheimera
##                                           4
##                             g__Rhodanobacter
##                                           4
##                          g__Rhodopseudomonas
##                                           4
##                                g__Romboutsia
##                                           4
##                                 g__Roseburia
##                                           4
##                                    g__Ruania
##                                           4
##                         g__Ruminiclostridium
##                                           4
##                                 g__Salipiger
##                                           4
##                                g__Salmonella
##                                           4
##                         g__Solidesulfovibrio
##                                           4
##                            g__Sphingorhabdus
##                                           4
##                               g__Spiribacter
##                                           4
##                               g__Terriglobus
##                                           4
##                             g__Thalassospira
##                                           4
##                           g__Thermaerobacter
##                                           4
##                     g__Thermoanaerobacterium
##                                           4
##                              g__Thermobifida
##                                           4
##                               g__Thermomonas
##                                           4
##                       g__Thermosynechococcus
##                                           4
##                          g__Thiomicrorhabdus
```

```
##                                                4
##                                      g__Thiomonas
##                                                4
##                                 g__Thomasclavelia
##                                                4
##                                    g__Trueperella
##                                                4
##                                   g__Xanthobacter
##                                                4
##                                    g__Xylanimonas
##                                                4
##                                  g__Aliarcobacter
##                                                5
##                             g__Altererythrobacter
##                                                5
##                                   g__Anaerococcus
##                                                5
##                                  g__Anaerocolumna
##                                                5
##                                  g__Anoxybacillus
##                                                5
##                                       g__Azospira
##                                                5
##                                    g__Brachyspira
##                                                5
##                                   g__Butyrivibrio
##                                                5
##                                     g__Calothrix
##                                                5
##                                  g__Chlorobaculum
##                                                5
##                                   g__Conexibacter
##                                                5
##                                    g__Coprococcus
##                                                5
##                                  g__Corallococcus
##                                                5
##                             g__Desulfitobacterium
##                                                5
##                                 g__Desulfosarcina
##                                                5
##                              g__Desulfosporosinus
##                                                5
##                                 g__Desulfuromonas
##                                                5
##                                     g__Echinicola
##                                                5
##                                g__Elizabethkingia
##                                                5
##                                 g__Endozoicomonas
##                                                5
##                                    g__Francisella
##                                                5
##                                        g__Frankia
```

```
##                                        5
##                                g__Gemella
##                                        5
##                              g__Georgenia
##                                        5
##                                g__Gimesia
##                                        5
##                               g__Kingella
##                                        5
##                       g__Komagataeibacter
##                                        5
##                      g__Lachnoclostridium
##                                        5
##                    g__Lactiplantibacillus
##                                        5
##                     g__Lentilactobacillus
##                                        5
##                      g__Levilactobacillus
##                                        5
##                          g__Limnohabitans
##                                        5
##                       g__Magnetospirillum
##                                        5
##                         g__Mammaliicoccus
##                                        5
##                            g__Marinomonas
##                                        5
##                            g__Megasphaera
##                                        5
##                           g__Metabacillus
##                                        5
##                          g__Methylococcus
##                                        5
##                             g__Nonomuraea
##                                        5
##                         g__Oceanobacillus
##                                        5
##                            g__Pediococcus
##                                        5
##                          g__Peptoniphilus
##                                        5
##                            g__Phaeobacter
##                                        5
##                            g__Phocaeicola
##                                        5
##                           g__Polaribacter
##                                        5
##                          g__Porphyromonas
##                                        5
##                               g__Priestia
##                                        5
##                             g__Raoultella
##                                        5
##                        g__Salinibacterium
```

```
##                                           5
##                               g__Serinicoccus
##                                           5
##                                   g__Shigella
##                                           5
##                                g__Skermanella
##                                           5
##                                    g__Sodalis
##                                           5
##                              g__Sphaerochaeta
##                                           5
##                         g__Thermoanaerobacter
##                                           5
##                           g__Thioalkalivibrio
##                                           5
##                               g__Tsukamurella
##                                           5
##                               g__Turicibacter
##                                           5
##                          g__Acidithiobacillus
##                                           6
##                                 g__Agrococcus
##                                           6
##                           g__Anaeromyxobacter
##                                           6
##                               g__Ancylobacter
##                                           6
##                            g__Arcanobacterium
##                                           6
##                                 g__Aureimonas
##                                           6
##                                 g__Bartonella
##                                           6
##                               g__Caballeronia
##                                           6
##                             g__Carnobacterium
##                                           6
##                         g__Cellulosimicrobium
##                                           6
##                                g__Clavibacter
##                                           6
##                                   g__Cohnella
##                                           6
##                                g__Cronobacter
##                                           6
##                              g__Cutibacterium
##                                           6
##                               g__Cytobacillus
##                                           6
##                          g__Dactylosporangium
##                                           6
##                                g__Dyadobacter
##                                           6
##                                     g__Dyella
```

```
##                                          6
##                           g__Erysipelothrix
##                                          6
##                                g__Geomonas
##                                          6
##                              g__Janibacter
##                                          6
##                               g__Leifsonia
##                                          6
##                            g__Leptolyngbya
##                                          6
##                             g__Macrococcus
##                                          6
##                              g__Mannheimia
##                                          6
##                            g__Microlunatus
##                                          6
##                               g__Muricauda
##                                          6
##                              g__Myxococcus
##                                          6
##                         g__Parageobacillus
##                                          6
##                             g__Pontibacter
##                                          6
##                       g__Prosthecochloris
##                                          6
##                                g__Rahnella
##                                          6
##                             g__Rubrobacter
##                                          6
##                            g__Ruminococcus
##                                          6
##                           g__Sulfurimonas
##                                          6
##                              g__Sulfurovum
##                                          6
##                             g__Veillonella
##                                          6
##                                g__Yersinia
##                                          6
##                            g__Actinomadura
##                                          7
##                              g__Aerococcus
##                                          7
##                            g__Chitinophaga
##                                          7
##                          g__Diaphorobacter
##                                          7
##                                 g__Dickeya
##                                          7
##                             g__Escherichia
##                                          7
##                             g__Geobacillus
```

```
##                                         7
##                              g__Halobacillus
##                                         7
##                           g__Halopseudomonas
##                                         7
##                              g__Jeotgalibaca
##                                         7
##                        g__Lacticaseibacillus
##                                         7
##                                g__Leisingera
##                                         7
##                            g__Methylocystis
##                                         7
##                              g__Micrococcus
##                                         7
##                               g__Microvirga
##                                         7
##                                g__Moraxella
##                                         7
##                             g__Nocardiopsis
##                                         7
##                             g__Peribacillus
##                                         7
##                              g__Providencia
##                                         7
##                          g__Pseudoduganella
##                                         7
##                                g__Ralstonia
##                                         7
##                               g__Roseomonas
##                                         7
##                              g__Roseovarius
##                                         7
##                                 g__Ruegeria
##                                         7
##                       g__Saccharomonospora
##                                         7
##                      g__Saccharopolyspora
##                                         7
##                           g__Stutzerimonas
##                                         7
##                              g__Acetobacter
##                                         8
##                          g__Actinobacillus
##                                         8
##                            g__Actinoplanes
##                                         8
##                                    g__Bosea
##                                         8
##                    g__Caldicellulosiruptor
##                                         8
##                            g__Cryobacterium
##                                         8
##                                  g__Dietzia
```

```
##                                          8
##                              g__Eubacterium
##                                          8
##                                g__Geobacter
##                                          8
##                             g__Herbaspirillum
##                                          8
##                              g__Kitasatospora
##                                          8
##                               g__Luteibacter
##                                          8
##                               g__Neobacillus
##                                          8
##                                 g__Pandoraea
##                                          8
##                           g__Parabacteroides
##                                          8
##                                g__Pedobacter
##                                          8
##                         g__Pseudoxanthomonas
##                                          8
##                              g__Qipengyuania
##                                          8
##                               g__Selenomonas
##                                          8
##                                  g__Shinella
##                                          8
##                                   g__Thauera
##                                          8
##                             g__Capnocytophaga
##                                          9
##                            g__Exiguobacterium
##                                          9
##                                 g__Kosakonia
##                                          9
##                                g__Legionella
##                                          9
##                                g__Leptospira
##                                          9
##                              g__Leptotrichia
##                                          9
##                         g__Ligilactobacillus
##                                          9
##                                  g__Listeria
##                                          9
##                                g__Luteimonas
##                                          9
##                            g__Mycolicibacter
##                                          9
##                            g__Mycoplasmopsis
##                                          9
##                                    g__Nostoc
##                                          9
##                        g__Ornithinimicrobium
```

```
## 9
## g__Pectobacterium
## 9
## g__Pseudonocardia
## 9
## g__Psychrobacter
## 9
## g__Rhodoferax
## 9
## g__Schaalia
## 9
## g__Spirosoma
## 9
## g__Tessaracoccus
## 9
## g__Vagococcus
## 9
## g__Variovorax
## 9
## g__Agromyces
## 10
## g__Alicyclobacillus
## 10
## g__Brucella
## 10
## g__Chromobacterium
## 10
## g__Companilactobacillus
## 10
## g__Janthinobacterium
## 10
## g__Lactococcus
## 10
## g__Limosilactobacillus
## 10
## g__Lysinibacillus
## 10
## g__Methylomonas
## 10
## g__Mucilaginibacter
## 10
## g__Pseudarthrobacter
## 10
## g__Rothia
## 10
## g__Sporosarcina
## 10
## g__Achromobacter
## 11
## g__Aeromicrobium
## 11
## g__Agrobacterium
## 11
## g__Alistipes
```

```
##                                       11
##                                g__Blautia
##                                       11
##                          g__Brevibacillus
##                                       11
##                            g__Caulobacter
##                                       11
##                                g__Erwinia
##                                       11
##                          g__Erythrobacter
##                                       11
##                       g__Faecalibacterium
##                                       11
##                        g__Glutamicibacter
##                                       11
##                           g__Helicobacter
##                                       11
##                         g__Hydrogenophaga
##                                       11
##                                g__Kocuria
##                                       11
##                      g__Pseudoalteromonas
##                                       11
##                          g__Rathayibacter
##                                       11
##                          g__Sinorhizobium
##                                       11
##                       g__Sphingobacterium
##                                       11
##                                g__Thermus
##                                       11
##                              g__Weissella
##                                       11
##                          g__Desulfovibrio
##                                       12
##                          g__Fusobacterium
##                                       12
##                            g__Leuconostoc
##                                       12
##                         g__Photobacterium
##                                       12
##                            g__Planococcus
##                                       12
##                    g__Pseudodesulfovibrio
##                                       12
##                            g__Spiroplasma
##                                       12
##                          g__Virgibacillus
##                                       12
##                        g__Brachybacterium
##                                       13
##                            g__Leucobacter
##                                       13
##                       g__Polynucleobacter
```

```
##                                         13
##                           g__Sulfitobacter
##                                         13
##                            g__Azospirillum
##                                         14
##                              g__Bordetella
##                                         14
##                               g__Comamonas
##                                         14
##                              g__Klebsiella
##                                         14
##                              g__Mycoplasma
##                                         14
##                           g__Microbulbifer
##                                         15
##                        g__Stenotrophomonas
##                                         16
##                             g__Xanthomonas
##                                         16
##                          g__Curtobacterium
##                                         17
##                                 g__Devosia
##                                         17
##                                g__Gordonia
##                                         17
##                            g__Marinobacter
##                                         17
##                         g__Novosphingobium
##                                         17
##                             g__Cupriavidus
##                                         18
##                                g__Massilia
##                                         18
##                        g__Methylobacterium
##                                         18
##                                 g__Pantoea
##                                         18
##                             g__Sphingobium
##                                         18
##                               g__Treponema
##                                         18
##                              g__Acidovorax
##                                         19
##                               g__Aeromonas
##                                         19
##                             g__Citrobacter
##                                         19
##                              g__Lysobacter
##                                         19
##                               g__Neisseria
##                                         19
##                            g__Sphingopyxis
##                                         19
##                            g__Enterobacter
```

```
##                                          20
##                                  g__Nocardia
##                                          20
##                                  g__Serratia
##                                          20
##                                g__Shewanella
##                                          21
##                             g__Brevibacterium
##                                          22
##                             g__Brevundimonas
##                                          22
##                              g__Cellulomonas
##                                          22
##                             g__Amycolatopsis
##                                          23
##                             g__Campylobacter
##                                          23
##                               g__Actinomyces
##                                          24
##                              g__Burkholderia
##                                          24
##                                g__Prevotella
##                                          24
##                               g__Deinococcus
##                                          25
##                            g__Flavobacterium
##                                          25
##                          g__Paraburkholderia
##                                          25
##                          g__Chryseobacterium
##                                          27
##                              g__Enterococcus
##                                          28
##                                 g__Rhizobium
##                                          28
##                                 g__Halomonas
##                                          29
##                              g__Hymenobacter
##                                          30
##                               g__Bacteroides
##                                          31
##                               g__Rhodococcus
##                                          31
##                                g__Paracoccus
##                                          32
##                             g__Acinetobacter
##                                          33
##                           g__Bifidobacterium
##                                          33
##                             g__Synechococcus
##                                          33
##                                    g__Vibrio
##                                          33
##                             g__Lactobacillus
```

```
##                                          34
##                            g__Mesorhizobium
##                                          35
##                             g__Arthrobacter
##                                          44
##                           g__Micromonospora
##                                          46
##                            g__Mycobacterium
##                                          47
##                             g__Nocardioides
##                                          47
##                        g__Mycolicibacterium
##                                          48
##                                 g__Bacillus
##                                          52
##                             g__Sphingomonas
##                                          52
##                           g__Bradyrhizobium
##                                          53
##                           g__Staphylococcus
##                                          53
##                              g__Clostridium
##                                          56
##                            g__Streptococcus
##                                          62
##                           g__Microbacterium
##                                          70
##                            g__Paenibacillus
##                                          99
##                          g__Corynebacterium
##                                         101
##                              g__Pseudomonas
##                                         148
##                                         g__
##                                         228
##                             g__Streptomyces
##                                         241
```

```
# Check the amount of unique Orders in samples which have and have not been treated with antibiotics
subsetMG %>% ps_filter(AB == "no") %>% get_taxa_unique("Order") # 200 different orders for non AB treat
```

```
##   [1] "o__Hyphomicrobiales"             "o__Burkholderiales"
##   [3] "o__Cytophagales"                 "o__Holosporales"
##   [5] "o__Lactobacillales"              "o__Bacillales"
##   [7] "o__Sphingobacteriales"           "o__Vibrionales"
##   [9] "o__Pseudomonadales"              "o__Chromatiales"
##  [11] "o__Micrococcales"                "o__Mycoplasmatales"
##  [13] "o__Kitasatosporales"             "o__Rhodobacterales"
##  [15] "o__Eubacteriales"                "o__Desulfuromonadales"
##  [17] "o__Syntrophobacterales"          "o__Nitrosomonadales"
##  [19] "o__Caulobacterales"              "o__Actinomycetales"
##  [21] "o__Opitutales"                   "o__Tissierellales"
##  [23] "o__Nostocales"                   "o__Veillonellales"
##  [25] "o__Neisseriales"                 "o__Myxococcales"
```

```
##  [27] "o__Enterobacterales"              "o__Propionibacteriales"
##  [29] "o__Methylococcales"               "o__Alteromonadales"
##  [31] "o__Natranaerobiales"              "o__Bifidobacteriales"
##  [33] "o__Sphingomonadales"              "o__Pasteurellales"
##  [35] "o__Xanthomonadales"               "o__Micromonosporales"
##  [37] "o__Cellvibrionales"               "o__Rhodospirillales"
##  [39] "o__Pseudonocardiales"             "o__Acidaminococcales"
##  [41] "o__Bacteroidales"                 "o__Chitinophagales"
##  [43] "o__Oceanospirillales"             "o__Deinococcales"
##  [45] "o__Campylobacterales"             "o__Pseudanabaenales"
##  [47] "o__Aeromonadales"                 "o__Mycobacteriales"
##  [49] "o__Desulfobacterales"             "o__Bryobacterales"
##  [51] "o__Hyphomonadales"                "o__Streptosporangiales"
##  [53] "o__Synechococcales"               "o__Thermosediminibacterales"
##  [55] "o__Flavobacteriales"              "o__Solirubrobacterales"
##  [57] "o__Chlorobiales"                  "o__"
##  [59] "o__Legionellales"                 "o__Acidiferrobacterales"
##  [61] "o__Terriglobales"                 "o__Polyangiales"
##  [63] "o__Spirochaetales"                "o__Verrucomicrobiales"
##  [65] "o__Tepidiformales"                "o__Rubrobacterales"
##  [67] "o__Candidatus Nanosynbacterales"  "o__Frankiales"
##  [69] "o__Moraxellales"                  "o__Eggerthellales"
##  [71] "o__Entomoplasmatales"             "o__Selenomonadales"
##  [73] "o__Desulfovibrionales"            "o__Pirellulales"
##  [75] "o__Mycoplasmoidales"              "o__Fusobacteriales"
##  [77] "o__Geobacterales"                 "o__Chlamydiales"
##  [79] "o__Rhodocyclales"                 "o__Methylacidiphilales"
##  [81] "o__Planctomycetales"              "o__Deferribacterales"
##  [83] "o__Erysipelotrichales"            "o__Parachlamydiales"
##  [85] "o__Acidimicrobiales"              "o__Acidithiobacillales"
##  [87] "o__Leptospirales"                 "o__Coriobacteriales"
##  [89] "o__Thiotrichales"                 "o__Rickettsiales"
##  [91] "o__Thermoanaerobacterales"        "o__Chroococcales"
##  [93] "o__Saprospirales"                 "o__Cardiobacteriales"
##  [95] "o__Desulfobulbales"               "o__Nevskiales"
##  [97] "o__Thermales"                     "o__Kordiimonadales"
##  [99] "o__Miltoncostaeales"              "o__Synergistales"
## [101] "o__Ktedonobacterales"             "o__Petrotogales"
## [103] "o__Oscillatoriales"               "o__Puniceicoccales"
## [105] "o__Nautiliales"                   "o__Thermotogales"
## [107] "o__Sedimentisphaerales"           "o__Kineosporiales"
## [109] "o__Acholeplasmatales"             "o__Anaerolineales"
## [111] "o__Candidatus Babeliales"         "o__Chloroflexales"
## [113] "o__Pleurocapsales"                "o__Nakamurellales"
## [115] "o__Nitrospirales"                 "o__Phototrophicales"
## [117] "o__Emcibacterales"                "o__Nitrospinales"
## [119] "o__Gemmatimonadales"              "o__Bradymonadales"
## [121] "o__Egibacterales"                 "o__Jatrophihabitantales"
## [123] "o__Brachyspirales"                "o__Sphaerobacterales"
## [125] "o__Gemmatales"                    "o__Moorellales"
## [127] "o__Halanaerobiales"               "o__Gloeobacterales"
## [129] "o__Desulfarculales"               "o__Isosphaerales"
## [131] "o__Orbales"                       "o__Dictyoglomales"
## [133] "o__Maricaulales"                  "o__Aquificales"
```

```
## [135] "o__Kosmotogales"                      "o__Koleobacterales"
## [137] "o__Geodermatophilales"                "o__Thermodesulfobacteriales"
## [139] "o__Marinilabiliales"                  "o__Thermostichales"
## [141] "o__Jiangellales"                      "o__Rhodothermales"
## [143] "o__Bdellovibrionales"                 "o__Acanthopleuribacterales"
## [145] "o__Ferrovales"                        "o__Glycomycetales"
## [147] "o__Thermomicrobiales"                 "o__Candidatus Nanopelagicales"
## [149] "o__Silvanigrellales"                  "o__Sneathiellales"
## [151] "o__Euzebyales"                        "o__Endomicrobiales"
## [153] "o__Tepidisphaerales"                  "o__Lentisphaerales"
## [155] "o__Thermoleophilales"                 "o__Kangiellales"
## [157] "o__Phycisphaerales"                   "o__Parvularculales"
## [159] "o__Candidatus Sulfidibacteriales" "o__Desulfobaccales"
## [161] "o__Tichowtungiales"                   "o__Sporichthyales"
## [163] "o__Caldisericales"                    "o__Dehalococcoidales"
## [165] "o__Immundisolibacterales"             "o__Desulfurobacteriales"
## [167] "o__Vicinamibacterales"                "o__Mariprofundales"
## [169] "o__Syntrophales"                      "o__Acidothermales"
## [171] "o__Desulfurellales"                   "o__Caldilineales"
## [173] "o__Trueperales"                       "o__Salinisphaerales"
## [175] "o__Haliangiales"                      "o__Bacteriovoracales"
## [177] "o__Candidatus Pelagibacterales"   "o__Chrysiogenales"
## [179] "o__Hydrogenophilales"                 "o__Desulfomonilales"
## [181] "o__Kiritimatiellales"                 "o__Elusimicrobiales"
## [183] "o__Catenulisporales"                  "o__Thermodesulfovibrionales"
## [185] "o__Actinopolysporales"                "o__Gloeomargaritales"
## [187] "o__Nannocystales"                     "o__Candidatus Izemoplasmatales"
## [189] "o__Calditrichales"                    "o__Chthonomonadales"
## [191] "o__Limnochordales"                    "o__Limisphaerales"
## [193] "o__Egicoccales"                       "o__Fimbriimonadales"
## [195] "o__Coprothermobacterales"             "o__Fibrobacterales"
## [197] "o__Chroococcidiopsidales"             "o__Balneolales"
## [199] "o__Mesoaciditogales"                  "o__Magnetococcales"
```

```
subsetMG %>% ps_filter(AB == "yes") %>% get_taxa_unique("Order") # 159 different orders for AB treated
```

```
##   [1] "o__Burkholderiales"                 "o__Cytophagales"
##   [3] "o__Hyphomicrobiales"                "o__Flavobacteriales"
##   [5] "o__Lactobacillales"                 "o__Bacillales"
##   [7] "o__Synechococcales"                 "o__Vibrionales"
##   [9] "o__Pseudomonadales"                 "o__Chromatiales"
##  [11] "o__Mycoplasmatales"                 "o__Kitasatosporales"
##  [13] "o__Rhodobacterales"                 "o__Eubacteriales"
##  [15] "o__Syntrophobacterales"             "o__Opitutales"
##  [17] "o__Tissierellales"                  "o__Veillonellales"
##  [19] "o__Neisseriales"                    "o__Myxococcales"
##  [21] "o__Enterobacterales"                "o__Propionibacteriales"
##  [23] "o__Bifidobacteriales"               "o__Xanthomonadales"
##  [25] "o__Actinomycetales"                 "o__Mycobacteriales"
##  [27] "o__Pseudonocardiales"               "o__Acidaminococcales"
##  [29] "o__Bacteroidales"                   "o__Oceanospirillales"
##  [31] "o__Rhodospirillales"                "o__Aeromonadales"
##  [33] "o__Desulfobacterales"               "o__Bryobacterales"
##  [35] "o__Micrococcales"                   "o__Pasteurellales"
```

```
## [37] "o__Spirochaetales"                "o__Solirubrobacterales"
## [39] "o__Micromonosporales"             "o__Phycisphaerales"
## [41] "o__Methylococcales"               "o__"
## [43] "o__Legionellales"                 "o__Campylobacterales"
## [45] "o__Terriglobales"                 "o__Polyangiales"
## [47] "o__Verrucomicrobiales"            "o__Rubrobacterales"
## [49] "o__Alteromonadales"               "o__Nostocales"
## [51] "o__Sphingomonadales"              "o__Candidatus Brocadiales"
## [53] "o__Rickettsiales"                 "o__Candidatus Saccharimonadales"
## [55] "o__Acidiferrobacterales"          "o__Eggerthellales"
## [57] "o__Entomoplasmatales"             "o__Selenomonadales"
## [59] "o__Desulfovibrionales"            "o__Pirellulales"
## [61] "o__Mycoplasmoidales"              "o__Geobacterales"
## [63] "o__Rhodocyclales"                 "o__Deinococcales"
## [65] "o__Nitrosomonadales"              "o__Aquificales"
## [67] "o__Planctomycetales"              "o__Erysipelotrichales"
## [69] "o__Caulobacterales"               "o__Candidatus Nanopelagicales"
## [71] "o__Acidimicrobiales"              "o__Acidithiobacillales"
## [73] "o__Leptospirales"                 "o__Coriobacteriales"
## [75] "o__Streptosporangiales"           "o__Moraxellales"
## [77] "o__Nautiliales"                   "o__Desulfuromonadales"
## [79] "o__Cardiobacteriales"             "o__Desulfobulbales"
## [81] "o__Miltoncostaeales"              "o__Fusobacteriales"
## [83] "o__Chitinophagales"               "o__Cellvibrionales"
## [85] "o__Sphingobacteriales"            "o__Thermoanaerobacterales"
## [87] "o__Puniceicoccales"               "o__Synergistales"
## [89] "o__Thermales"                     "o__Sedimentisphaerales"
## [91] "o__Kineosporiales"                "o__Acholeplasmatales"
## [93] "o__Anaerolineales"                "o__Chloroflexales"
## [95] "o__Nakamurellales"                "o__Nitrospirales"
## [97] "o__Parachlamydiales"              "o__Thermodesulfobacteriales"
## [99] "o__Oscillatoriales"               "o__Emcibacterales"
## [101] "o__Nitrospinales"                "o__Bradymonadales"
## [103] "o__Frankiales"                   "o__Sphaerobacterales"
## [105] "o__Gemmatales"                   "o__Chlorobiales"
## [107] "o__Moorellales"                  "o__Halanaerobiales"
## [109] "o__Desulfarculales"              "o__Gemmatimonadales"
## [111] "o__Isosphaerales"                "o__Thiotrichales"
## [113] "o__Thermosediminibacterales"     "o__Gloeobacterales"
## [115] "o__Tepidiformales"               "o__Koleobacterales"
## [117] "o__Geodermatophilales"           "o__Brachyspirales"
## [119] "o__Bdellovibrionales"            "o__Acanthopleuribacterales"
## [121] "o__Rhodothermales"               "o__Orbales"
## [123] "o__Nevskiales"                   "o__Petrotogales"
## [125] "o__Thermotogales"                "o__Glycomycetales"
## [127] "o__Pseudanabaenales"             "o__Sneathiellales"
## [129] "o__Chroococcales"                "o__Euzebyales"
## [131] "o__Parvularculales"              "o__Desulfobaccales"
## [133] "o__Tichowtungiales"              "o__Sporichthyales"
## [135] "o__Dehalococcoidales"            "o__Immundisolibacterales"
## [137] "o__Marinilabiliales"             "o__Vicinamibacterales"
## [139] "o__Candidatus Babeliales"        "o__Thermodesulfovibrionales"
## [141] "o__Caldilineales"                "o__Haliangiales"
## [143] "o__Candidatus Pelagibacterales"  "o__Kosmotogales"
```

```
## [145] "o__Thermotomaculales"            "o__Desulfomonilales"
## [147] "o__Kiritimatiellales"            "o__Gloeomargaritales"
## [149] "o__Nannocystales"                "o__Jiangellales"
## [151] "o__Candidatus Nanosynbacterales" "o__Candidatus Izemoplasmatales"
## [153] "o__Limnochordales"               "o__Limisphaerales"
## [155] "o__Egicoccales"                  "o__Fimbriimonadales"
## [157] "o__Fibrobacterales"              "o__Mesoaciditogales"
## [159] "o__Maricaulales"
```

```
subsetMG %>% get_taxa_unique("Order") # 203 different order in total, so 3 orders are not found in non
```

```
##   [1] "o__Hyphomicrobiales"              "o__Burkholderiales"
##   [3] "o__Cytophagales"                  "o__Holosporales"
##   [5] "o__Flavobacteriales"              "o__Lactobacillales"
##   [7] "o__Bacillales"                    "o__Synechococcales"
##   [9] "o__Sphingobacteriales"            "o__Vibrionales"
##  [11] "o__Pseudomonadales"               "o__Chromatiales"
##  [13] "o__Micrococcales"                 "o__Mycoplasmatales"
##  [15] "o__Kitasatosporales"              "o__Rhodobacterales"
##  [17] "o__Eubacteriales"                 "o__Desulfuromonadales"
##  [19] "o__Syntrophobacterales"           "o__Nitrosomonadales"
##  [21] "o__Caulobacterales"               "o__Actinomycetales"
##  [23] "o__Opitutales"                    "o__Tissierellales"
##  [25] "o__Nostocales"                    "o__Veillonellales"
##  [27] "o__Neisseriales"                  "o__Myxococcales"
##  [29] "o__Enterobacterales"              "o__Propionibacteriales"
##  [31] "o__Methylococcales"               "o__Alteromonadales"
##  [33] "o__Natranaerobiales"              "o__Bifidobacteriales"
##  [35] "o__Sphingomonadales"              "o__Pasteurellales"
##  [37] "o__Xanthomonadales"               "o__Micromonosporales"
##  [39] "o__Cellvibrionales"               "o__Rhodospirillales"
##  [41] "o__Mycobacteriales"               "o__Pseudonocardiales"
##  [43] "o__Acidaminococcales"             "o__Bacteroidales"
##  [45] "o__Chitinophagales"               "o__Oceanospirillales"
##  [47] "o__Deinococcales"                 "o__Campylobacterales"
##  [49] "o__Pseudanabaenales"              "o__Aeromonadales"
##  [51] "o__Desulfobacterales"             "o__Bryobacterales"
##  [53] "o__Hyphomonadales"                "o__Streptosporangiales"
##  [55] "o__Spirochaetales"                "o__Thermosediminibacterales"
##  [57] "o__Solirubrobacterales"           "o__Chlorobiales"
##  [59] "o__Phycisphaerales"               "o__"
##  [61] "o__Legionellales"                 "o__Acidiferrobacterales"
##  [63] "o__Terriglobales"                 "o__Polyangiales"
##  [65] "o__Verrucomicrobiales"            "o__Tepidiformales"
##  [67] "o__Rubrobacterales"               "o__Candidatus Nanosynbacterales"
##  [69] "o__Candidatus Brocadiales"        "o__Frankiales"
##  [71] "o__Rickettsiales"                 "o__Candidatus Saccharimonadales"
##  [73] "o__Moraxellales"                  "o__Eggerthellales"
##  [75] "o__Entomoplasmatales"             "o__Selenomonadales"
##  [77] "o__Desulfovibrionales"            "o__Pirellulales"
##  [79] "o__Mycoplasmoidales"              "o__Fusobacteriales"
##  [81] "o__Geobacterales"                 "o__Rhodocyclales"
##  [83] "o__Aquificales"                   "o__Chlamydiales"
##  [85] "o__Methylacidiphilales"           "o__Planctomycetales"
```

```
##  [87] "o__Deferribacterales"             "o__Erysipelotrichales"
##  [89] "o__Candidatus Nanopelagicales"    "o__Parachlamydiales"
##  [91] "o__Acidimicrobiales"              "o__Acidithiobacillales"
##  [93] "o__Leptospirales"                 "o__Coriobacteriales"
##  [95] "o__Thiotrichales"                 "o__Thermoanaerobacterales"
##  [97] "o__Nautiliales"                   "o__Chroococcales"
##  [99] "o__Saprospirales"                 "o__Cardiobacteriales"
## [101] "o__Desulfobulbales"               "o__Nevskiales"
## [103] "o__Thermales"                     "o__Kordiimonadales"
## [105] "o__Miltoncostaeales"              "o__Synergistales"
## [107] "o__Ktedonobacterales"             "o__Petrotogales"
## [109] "o__Oscillatoriales"               "o__Puniceicoccales"
## [111] "o__Thermotogales"                 "o__Sedimentisphaerales"
## [113] "o__Kineosporiales"                "o__Acholeplasmatales"
## [115] "o__Anaerolineales"                "o__Candidatus Babeliales"
## [117] "o__Chloroflexales"                "o__Pleurocapsales"
## [119] "o__Nakamurellales"                "o__Nitrospirales"
## [121] "o__Phototrophicales"              "o__Thermodesulfobacteriales"
## [123] "o__Emcibacterales"                "o__Nitrospinales"
## [125] "o__Gemmatimonadales"              "o__Bradymonadales"
## [127] "o__Egibacterales"                 "o__Jatrophihabitantales"
## [129] "o__Brachyspirales"                "o__Sphaerobacterales"
## [131] "o__Gemmatales"                    "o__Moorellales"
## [133] "o__Halanaerobiales"               "o__Gloeobacterales"
## [135] "o__Desulfarculales"               "o__Isosphaerales"
## [137] "o__Orbales"                       "o__Dictyoglomales"
## [139] "o__Maricaulales"                  "o__Kosmotogales"
## [141] "o__Koleobacterales"               "o__Geodermatophilales"
## [143] "o__Marinilabiliales"              "o__Thermostichales"
## [145] "o__Jiangellales"                  "o__Rhodothermales"
## [147] "o__Bdellovibrionales"             "o__Acanthopleuribacterales"
## [149] "o__Ferrovales"                    "o__Glycomycetales"
## [151] "o__Thermomicrobiales"             "o__Silvanigrellales"
## [153] "o__Sneathiellales"                "o__Euzebyales"
## [155] "o__Endomicrobiales"               "o__Tepidisphaerales"
## [157] "o__Lentisphaerales"               "o__Thermoleophilales"
## [159] "o__Kangiellales"                  "o__Parvularculales"
## [161] "o__Candidatus Sulfidibacteriales" "o__Desulfobaccales"
## [163] "o__Tichowtungiales"               "o__Sporichthyales"
## [165] "o__Caldisericales"                "o__Dehalococcoidales"
## [167] "o__Immundisolibacterales"         "o__Desulfurobacteriales"
## [169] "o__Vicinamibacterales"            "o__Mariprofundales"
## [171] "o__Syntrophales"                  "o__Acidothermales"
## [173] "o__Desulfurellales"               "o__Thermodesulfovibrionales"
## [175] "o__Caldilineales"                 "o__Trueperales"
## [177] "o__Salinisphaerales"              "o__Haliangiales"
## [179] "o__Bacteriovoracales"             "o__Candidatus Pelagibacterales"
## [181] "o__Chrysiogenales"                "o__Hydrogenophilales"
## [183] "o__Thermotomaculales"             "o__Desulfomonilales"
## [185] "o__Kiritimatiellales"             "o__Elusimicrobiales"
## [187] "o__Catenulisporales"              "o__Actinopolysporales"
## [189] "o__Gloeomargaritales"             "o__Nannocystales"
## [191] "o__Candidatus Izemoplasmatales"   "o__Calditrichales"
## [193] "o__Chthonomonadales"              "o__Limnochordales"
```

```
## [195] "o__Limisphaerales"                "o__Egicoccales"
## [197] "o__Fimbriimonadales"              "o__Coprothermobacterales"
## [199] "o__Fibrobacterales"               "o__Chroococcidiopsidales"
## [201] "o__Balneolales"                   "o__Mesoaciditogales"
## [203] "o__Magnetococcales"
```

```
# Check the amount of unique Species in samples which have and have not been treated with antibiotics
subsetMG %>% ps_filter(AB == "no") %>% get_taxa_unique("Species") # 4464 different orders for non AB tr
```

```
##    [1] "s__symbiodeficiens"
##    [2] "s__sp. LM6"
##    [3] "s__sp. 5116S-3"
##    [4] "s__sp. 32K"
##    [5] "s__endosymbiont of Acanthamoeba sp. UWC8"
##    [6] "s__sp. CR-Ec1"
##    [7] "s__rosea"
##    [8] "s__malaysiensis"
##    [9] "s__leguminosarum"
##   [10] "s__larvae"
##   [11] "s__paramultivorum"
##   [12] "s__sp. TY1-4"
##   [13] "s__endophytica"
##   [14] "s__flavum"
##   [15] "s__genomosp. 3"
##   [16] "s__sp. RR6"
##   [17] "s__mengziensis"
##   [18] "s__"
##   [19] "s__sp. ATA002"
##   [20] "s__equigenitalium"
##   [21] "s__sp. NEAU-sy36"
##   [22] "s__sp. M2A.F.Ca.ET.046.03.2.1"
##   [23] "s__gei"
##   [24] "s__vestfoldensis"
##   [25] "s__septicum"
##   [26] "s__alkanexedens"
##   [27] "s__emersonii"
##   [28] "s__sp. LH3H17"
##   [29] "s__sp. oral taxon 414"
##   [30] "s__sp. ESL0677"
##   [31] "s__sphaeroides"
##   [32] "s__luteus"
##   [33] "s__gaetbulicola"
##   [34] "s__mirabilis"
##   [35] "s__prevotii"
##   [36] "s__sp. DMV24BSW_D"
##   [37] "s__commune"
##   [38] "s__testudinis"
##   [39] "s__macrosporus"
##   [40] "s__sp. SCLE84"
##   [41] "s__tepida"
##   [42] "s__sp. MC1595"
##   [43] "s__everestensis"
##   [44] "s__oryzae"
##   [45] "s__caldiproteolyticus"
```

```
##  [46] "s__sp. MTB7"
##  [47] "s__difficile"
##  [48] "s__dentium"
##  [49] "s__sp. E76"
##  [50] "s__gangjinensis"
##  [51] "s__sp. LQ44"
##  [52] "s__profundi"
##  [53] "s__australis"
##  [54] "s__avium"
##  [55] "s__[Mannheimia] succiniciproducens"
##  [56] "s__arboricola"
##  [57] "s__chokoriensis"
##  [58] "s__sp. PSBB023"
##  [59] "s__palleroniana"
##  [60] "s__abyssi"
##  [61] "s__qiguomingii"
##  [62] "s__tangfeifanii"
##  [63] "s__cyanobacteriorum"
##  [64] "s__gloriosae"
##  [65] "s__intestini"
##  [66] "s__glaucescens"
##  [67] "s__sp. RSMS"
##  [68] "s__propionicum"
##  [69] "s__alhagiae"
##  [70] "s__aestuarii"
##  [71] "s__gelatinosa"
##  [72] "s__sp. DHT3"
##  [73] "s__indolicus"
##  [74] "s__sp. 14171R-50"
##  [75] "s__ruminicola"
##  [76] "s__sp. PSKL.D1"
##  [77] "s__haemaphysalidis"
##  [78] "s__sp. 19OD2882"
##  [79] "s__actinosclerus"
##  [80] "s__suis"
##  [81] "s__manihotivorum"
##  [82] "s__sp. VBCF_01 NA2"
##  [83] "s__deleyi"
##  [84] "s__sp. HN-54"
##  [85] "s__sp. OT10"
##  [86] "s__bestiarum"
##  [87] "s__ulcerans"
##  [88] "s__pogona"
##  [89] "s__pseudopelargi"
##  [90] "s__sp. Csp1"
##  [91] "s__vannielii"
##  [92] "s__lutetiensis"
##  [93] "s__kobei"
##  [94] "s__fermentans"
##  [95] "s__sp. HMF3514"
##  [96] "s__sp. CACIAM 19H1"
##  [97] "s__akebiae"
##  [98] "s__sp. WJP83"
##  [99] "s__sp. Y-01"
```

```
## [100] "s__thermophilus"
## [101] "s__tsuruhatensis"
## [102] "s__porcitonsillarum"
## [103] "s__farcinica"
## [104] "s__robiniae"
## [105] "s__sp. PDNC005"
## [106] "s__sp. CB0101"
## [107] "s__acidurici"
## [108] "s__radiodurans"
## [109] "s__gryphiswaldense"
## [110] "s__lacunae"
## [111] "s__acetatoxydans"
## [112] "s__taklimakanense"
## [113] "s__flava"
## [114] "s__parvum"
## [115] "s__aurantiacus"
## [116] "s__sp. KBS50"
## [117] "s__tepidum"
## [118] "s__salmonicida"
## [119] "s__sp. B53371"
## [120] "s__gilvus"
## [121] "s__sp. SL97"
## [122] "s__sanguinis"
## [123] "s__boonkerdii"
## [124] "s__endosymbiont 'TC1' of Trimyema compressum"
## [125] "s__harei"
## [126] "s__inhibens"
## [127] "s__seropedicae"
## [128] "s__ambofaciens"
## [129] "s__lytica"
## [130] "s__mobilis"
## [131] "s__cyanea"
## [132] "s__extorquens"
## [133] "s__aurantiacum"
## [134] "s__choladocola"
## [135] "s__torquis"
## [136] "s__dioxanivorans"
## [137] "s__sp. GK1"
## [138] "s__sp. FJAT-42376"
## [139] "s__sp. cx-51"
## [140] "s__sp. InS609-2"
## [141] "s__marinum"
## [142] "s__seohaensis"
## [143] "s__polymyxa"
## [144] "s__sp. N"
## [145] "s__sp. EV170708-02-1"
## [146] "s__lutea"
## [147] "s__nitratireducens"
## [148] "s__heimbachae"
## [149] "s__halophilus"
## [150] "s__variabilis"
## [151] "s__saerimneri"
## [152] "s__griseocarneus"
## [153] "s__ultunensis"
```

```
## [154] "s__sp. YIM 121038"
## [155] "s__roseus"
## [156] "s__guangdongense"
## [157] "s__sp. SN-593"
## [158] "s__waltersii"
## [159] "s__microcysteis"
## [160] "s__plicata"
## [161] "s__sp. PL-2018"
## [162] "s__sp. S09G 359"
## [163] "s__succinifaciens"
## [164] "s__sunshinyii"
## [165] "s__naejangsanensis"
## [166] "s__weaveri"
## [167] "s__sp. SK17"
## [168] "s__reducens"
## [169] "s__insidiosa"
## [170] "s__sp. YPW16"
## [171] "s__curvus"
## [172] "s__thermophilum"
## [173] "s__Candidatus Arsenophonus lipoptenae"
## [174] "s__sp. GAS474"
## [175] "s__denitrificans"
## [176] "s__sp. H1-7"
## [177] "s__geothermalis"
## [178] "s__sp. W1SF4"
## [179] "s__sp. D3"
## [180] "s__aestuariivivens"
## [181] "s__caledonica"
## [182] "s__sp. 19GGS1-52"
## [183] "s__bonchosmolovskayae"
## [184] "s__koreensis"
## [185] "s__ianthinogenes"
## [186] "s__sp. Xi13"
## [187] "s__lacustris"
## [188] "s__agarilyticus"
## [189] "s__sp. R3"
## [190] "s__sp. IBH004"
## [191] "s__sp. TCL240-02"
## [192] "s__changnyeongensis"
## [193] "s__featherlites"
## [194] "s__terpenica"
## [195] "s__wadenswilerensis"
## [196] "s__thiooxidans"
## [197] "s__balearica"
## [198] "s__ulvae"
## [199] "s__audaxviator"
## [200] "s__sp. AJA081-3"
## [201] "s__sp. YMD87"
## [202] "s__longhuiensis"
## [203] "s__inefficax"
## [204] "s__sp. MX-AZ03"
## [205] "s__sp. 113-3-9"
## [206] "s__confusa"
## [207] "s__sp. M92"
```

```
## [208] "s__carolinensis"
## [209] "s__gilva"
## [210] "s__sp. TGL-Y2"
## [211] "s__sp. E35C"
## [212] "s__riegelii"
## [213] "s__sp. LMS6"
## [214] "s__hiranonis"
## [215] "s__sp. Z13"
## [216] "s__sp. JY-X169"
## [217] "s__syrphidicola"
## [218] "s__lujinxingii"
## [219] "s__adiacens"
## [220] "s__suranareeae"
## [221] "s__sp. Wa41.01b-1"
## [222] "s__frigoritolerans"
## [223] "s__sputigena"
## [224] "s__defluvii"
## [225] "s__nasimurium"
## [226] "s__sonchi"
## [227] "s__xinjiangensis"
## [228] "s__sp. zrk46"
## [229] "s__sp. StoSoilB20"
## [230] "s__sp. J2-11"
## [231] "s__viridifaciens"
## [232] "s__musculi"
## [233] "s__iowae"
## [234] "s__fungivorans"
## [235] "s__polymorphum"
## [236] "s__soli"
## [237] "s__vitis"
## [238] "s__hyicus"
## [239] "s__nodosus"
## [240] "s__freneyi"
## [241] "s__sedimenticola"
## [242] "s__delphinicola"
## [243] "s__haeundaensis"
## [244] "s__gobiensis"
## [245] "s__zundukense"
## [246] "s__bremense"
## [247] "s__stearothermophilus"
## [248] "s__sp. FHR47"
## [249] "s__sp. 5317J-9"
## [250] "s__sp. PAMC28688"
## [251] "s__aquaticus"
## [252] "s__rhamnosus"
## [253] "s__lacus"
## [254] "s__sp. IDR2000157661"
## [255] "s__terrae"
## [256] "s__coyleae"
## [257] "s__dokdonensis"
## [258] "s__pigmentatum"
## [259] "s__oceani"
## [260] "s__sp. A34"
## [261] "s__khirikhana"
```

```
## [262] "s__sp. YST-16"
## [263] "s__sp. SMBL-WEM22"
## [264] "s__polymorphus"
## [265] "s__clarkii"
## [266] "s__schleiferi"
## [267] "s__sp. 3B(2020)"
## [268] "s__finlayi"
## [269] "s__armeniacus"
## [270] "s__infernorum"
## [271] "s__pseudintermedia"
## [272] "s__chengjingii"
## [273] "s__otitidis"
## [274] "s__algicola"
## [275] "s__sp. 17Sr1-1"
## [276] "s__ponti"
## [277] "s__sp. MIT S9220"
## [278] "s__sp. C1"
## [279] "s__gambrini"
## [280] "s__sp. SH-PL14"
## [281] "s__calystegiae"
## [282] "s__liaowanqingii"
## [283] "s__amarae"
## [284] "s__gelatinosus"
## [285] "s__sp. HS-3"
## [286] "s__sinusarabici"
## [287] "s__sp. FJAT-22090"
## [288] "s__mesenteroides"
## [289] "s__paludis"
## [290] "s__intestinalis"
## [291] "s__intermedia"
## [292] "s__agilis"
## [293] "s__desulfuricans"
## [294] "s__sp. MH6"
## [295] "s__vietnamiensis"
## [296] "s__fluoranthenivorans"
## [297] "s__sp. H13-6"
## [298] "s__izadpanahii"
## [299] "s__sp. S1-8"
## [300] "s__pinatubonensis"
## [301] "s__marina"
## [302] "s__agri"
## [303] "s__lapagei"
## [304] "s__swuensis"
## [305] "s__cuenoti"
## [306] "s__negevensis"
## [307] "s__rigui"
## [308] "s__pyridinivorans"
## [309] "s__sp. SCSIO 61187"
## [310] "s__caldus"
## [311] "s__sulfonylureivorans"
## [312] "s__parakoreensis"
## [313] "s__parva"
## [314] "s__multivorans"
## [315] "s__tropicus"
```

```
## [316] "s__sp. KH3-4"
## [317] "s__creviioricanis"
## [318] "s__broussonetiae"
## [319] "s__sp. oral taxon 807"
## [320] "s__staleyi"
## [321] "s__ruber"
## [322] "s__baltica"
## [323] "s__sp. FB-5"
## [324] "s__atsumiense"
## [325] "s__amnigena"
## [326] "s__sp. PLM1"
## [327] "s__mishrai"
## [328] "s__uli"
## [329] "s__palythoae"
## [330] "s__sp. ZAC14A_NAIMI4_1"
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## [333] "s__branconii"
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## [339] "s__sp. M317"
## [340] "s__doucetiae"
## [341] "s__sp. ZFBP2030"
## [342] "s__pachyrhizi"
## [343] "s__hadrus"
## [344] "s__pecorum"
## [345] "s__sp. SM18"
## [346] "s__sp. TC1"
## [347] "s__sp. NIBR1757"
## [348] "s__sp. Allo2"
## [349] "s__condimenti"
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## [351] "s__bonaserana"
## [352] "s__sp. WY228"
## [353] "s__ficus"
## [354] "s__sp. ASNIH4"
## [355] "s__sp. WAC 06738"
## [356] "s__thiocyanaticus"
## [357] "s__sp. SD9660Na"
## [358] "s__sp. SYP-B4668"
## [359] "s__sp. TS-1"
## [360] "s__radiophilus"
## [361] "s__sp. OMZ 787"
## [362] "s__dioscoreae"
## [363] "s__coli"
## [364] "s__budapestensis"
## [365] "s__oculi"
## [366] "s__natechei"
## [367] "s__sp. SDW2"
## [368] "s__sp. NIES-981"
## [369] "s__circulans"
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## [372] "s__phyllanthi"
## [373] "s__sp. 20G"
## [374] "s__sp. CAP-1"
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## [376] "s__sp. M344"
## [377] "s__thailandicus"
## [378] "s__dauci"
## [379] "s__sp. SAT1"
## [380] "s__sp. HW608"
## [381] "s__shayeganii"
## [382] "s__rhizoryzae"
## [383] "s__sp. DA9"
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## [385] "s__dokdonellae"
## [386] "s__pedis"
## [387] "s__cucullus"
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## [390] "s__ginsenosidimutans"
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## [392] "s__bronchialis"
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## [395] "s__pakistanensis"
## [396] "s__sp. ZJ405"
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## [399] "s__dentocariosa"
## [400] "s__jejuni"
## [401] "s__timonensis"
## [402] "s__italicus"
## [403] "s__protophormiae"
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## [406] "s__spongiae"
## [407] "s__crassostreae"
## [408] "s__rubrum"
## [409] "s__pabuli"
## [410] "s__rustigianii"
## [411] "s__fischeri"
## [412] "s__coelicolor"
## [413] "s__jeotgali"
## [414] "s__africanus"
## [415] "s__sp. 12200R-103"
## [416] "s__melaninogenica"
## [417] "s__sp. MG-5-Ahmo-C2"
## [418] "s__sp. N902-109"
## [419] "s__sp. 2438"
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## [422] "s__sp. YTS05"
## [423] "s__jinjuensis"
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## [428] "s__sp. ORS 285"
## [429] "s__zeae"
## [430] "s__sp. CB3481"
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## [432] "s__Candidatus Desulfovibrio trichonymphae"
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## [435] "s__sp. WMMD975"
## [436] "s__kansasii"
## [437] "s__troglodytae"
## [438] "s__profunda"
## [439] "s__butanolivorans"
## [440] "s__zhangzhiyongii"
## [441] "s__pyrrocinia"
## [442] "s__sp. Marseille-Q3772"
## [443] "s__sp. ES10-3-2-2"
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## [445] "s__filamentosa"
## [446] "s__aeruginosa"
## [447] "s__hinzii"
## [448] "s__parasuis"
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## [451] "s__sp. KUDC0406"
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## [468] "s__sp. erpn"
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## [471] "s__parmentieri"
## [472] "s__sp. CA-103260"
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## [475] "s__sp. 891-h"
## [476] "s__butyriciproducens"
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## [487] "s__sp. SY8519"
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## [489] "s__sp. FW306-05-C"
## [490] "s__sp. KY-GH-1"
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## [492] "s__aggregatum"
## [493] "s__sp. PBL-H3"
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## [496] "s__sp. PROS-U-1"
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## [498] "s__sp. FDAARGOS_506"
## [499] "s__sp. PAMC 26628"
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## [506] "s__sp. AP4-R1"
## [507] "s__sp. SVR"
## [508] "s__anaerophila"
## [509] "s__sp. M54"
## [510] "s__luteola"
## [511] "s__solani"
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## [514] "s__sp. HF10"
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## [516] "s__salarius"
## [517] "s__cedrina"
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## [525] "s__armeniaca"
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## [527] "s__viridans"
## [528] "s__sp. StoSoilA2"
## [529] "s__moriokaense"
## [530] "s__brennaborense"
## [531] "s__sp. GL2"
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## [539] "s__sp. CT06"
## [540] "s__sp. NEB1569"
## [541] "s__brunensis"
## [542] "s__jostii"
## [543] "s__sp. B21-053"
## [544] "s__sp. AS-1"
## [545] "s__yuyongxinii"
## [546] "s__sp. SCSIO W1101"
## [547] "s__sp. 17 mud 1-3"
## [548] "s__tokaiense"
## [549] "s__oryzoeni"
## [550] "s__iowensis"
## [551] "s__bovis"
## [552] "s__frisingensis"
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## [558] "s__pumila"
## [559] "s__sp. PSB04"
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## [561] "s__sp. BMK-MC-1"
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## [565] "s__sp. WJP1"
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## [569] "s__sp. AA4"
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## [571] "s__marinus"
## [572] "s__funiformis"
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## [574] "s__sp. MSJ-33"
## [575] "s__sp. QXT-31"
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## [577] "s__sp. M7H15-1"
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## [579] "s__sp. MMS18-M83"
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## [583] "s__sp. VNUA24"
## [584] "s__citri"
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## [590] "s__sp. WS"
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## [595] "s__riparius"
## [596] "s__sp. JS666"
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## [598] "s__cellulosilytica"
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## [600] "s__rubrisoli"
## [601] "s__taeniospiralis"
## [602] "s__platys"
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## [614] "s__sp. 313"
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## [633] "s__jeikeium"
## [634] "s__sp. WM"
## [635] "s__prydzensis"
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## [638] "s__bryophila"
## [639] "s__sagamiensis"
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## [650] "s__sp. NR 4-1"
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## [653] "s__sp. AT1b"
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## [656] "s__sp. CF8"
## [657] "s__vulgaris"
## [658] "s__sp. HUAS 3"
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## [674] "s__sp. SSS035"
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## [686] "s__sp. EFPC3"
## [687] "s__sp. L1A9"
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## [690] "s__sp. TUM22785"
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## [704] "s__diernhoferi"
## [705] "s__vallismortis"
## [706] "s__dendaii"
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## [708] "s__grimesii"
## [709] "s__sp. 3211"
## [710] "s__caeni"
## [711] "s__sp. PCC 6303"
## [712] "s__yunxiaonensis"
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## [722] "s__saguini"
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## [742] "s__protaetiae"
## [743] "s__hiltneri"
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## [765] "s__sp. RF6"
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## [773] "s__sp. M7A.F.Ce.TU.012.03.2.1"
## [774] "s__sp. KS 6"
## [775] "s__keddieii"
## [776] "s__antranikianii"
## [777] "s__radingae"
## [778] "s__mercurii"
## [779] "s__Enterobacteriaceae endosymbiont of Donacia cinerea"
## [780] "s__gauvreauii"
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## [874] "s__benzenivorans"
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## [881] "s__sp. MP-37"
## [882] "s__portuensis"
## [883] "s__sp. XGS7"
## [884] "s__sp. 4G"
## [885] "s__sp. SK012"
## [886] "s__woosongensis"
## [887] "s__amylolytica"
## [888] "s__carnosus"
## [889] "s__nuruki"
## [890] "s__ruckeri"
## [891] "s__sp. 32O-W"
## [892] "s__propionicus"
## [893] "s__sp. LS44"
## [894] "s__chitinolytica"
## [895] "s__antarctica"
## [896] "s__sp. S190"
## [897] "s__ludwigii"
## [898] "s__putida"
## [899] "s__sp. NCPPB 2350"
## [900] "s__asteroides"
## [901] "s__incerta"
## [902] "s__woluwensis"
## [903] "s__haemolyticus"
## [904] "s__aquimaris"
## [905] "s__manosquense"
## [906] "s__pseudoperiodonticum"
## [907] "s__armoricus"
## [908] "s__canicola"
## [909] "s__vandammei"
```

```
## [910] "s__dumoffii"
## [911] "s__endopervernicosa"
## [912] "s__crispatus"
## [913] "s__sp. MMS16-BH015"
## [914] "s__calvum"
## [915] "s__parasyntrophica"
## [916] "s__persicina"
## [917] "s__mediterraneus"
## [918] "s__algae"
## [919] "s__carbinolica"
## [920] "s__sp. BS20"
## [921] "s__gaoshouyii"
## [922] "s__callunae"
## [923] "s__sp. DSM 40750"
## [924] "s__sp. Lep1P3"
## [925] "s__zoogleoformans"
## [926] "s__psoromatis"
## [927] "s__argentoratensis"
## [928] "s__indica"
## [929] "s__sp. KK10"
## [930] "s__tirandamycinicus"
## [931] "s__rubeus"
## [932] "s__sp. AU20"
## [933] "s__celer"
## [934] "s__adhaerens"
## [935] "s__chocolatum"
## [936] "s__shahii"
## [937] "s__thermocarboxydus"
## [938] "s__japonicus"
## [939] "s__defectiva"
## [940] "s__indistinctus"
## [941] "s__watsonii"
## [942] "s__sp. NA07423"
## [943] "s__alkaliphilus"
## [944] "s__sp. PS1209"
## [945] "s__caribensis"
## [946] "s__calida"
## [947] "s__glucanolyticus"
## [948] "s__nitrativorans"
## [949] "s__kumadai"
## [950] "s__cyriacigeorgica"
## [951] "s__panacisegetis"
## [952] "s__phlei"
## [953] "s__sp. BB1"
## [954] "s__alkaliphilum"
## [955] "s__argenteus"
## [956] "s__sp. A2M4"
## [957] "s__sp. V7"
## [958] "s__sp. HKS 07"
## [959] "s__[Phormidium] sp. ETS-05"
## [960] "s__moscoviensis"
## [961] "s__hermannii"
## [962] "s__sp. CB3171"
## [963] "s__sp. HM190"
```

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## [964] "s__jiangjiafuii"
## [965] "s__sp. SL306"
## [966] "s__sp. SS37A-Re"
## [967] "s__sp. B21-019"
## [968] "s__collinus"
## [969] "s__ixodetis"
## [970] "s__chiangmaiensis"
## [971] "s__actinocoloniiforme"
## [972] "s__halioticida"
## [973] "s__sp. SY7"
## [974] "s__oligotrophicum"
## [975] "s__michiganensis"
## [976] "s__sp. BRM-1"
## [977] "s__formosus"
## [978] "s__Candidatus Thiodictyon syntrophicum"
## [979] "s__papyrosolvens"
## [980] "s__anthracis"
## [981] "s__methaneseepsis"
## [982] "s__yongneupense"
## [983] "s__flagellatus"
## [984] "s__dentiae"
## [985] "s__sp. PV034"
## [986] "s__africana"
## [987] "s__koseri"
## [988] "s__manihotivorans"
## [989] "s__proteoclasticus"
## [990] "s__sichuanensis"
## [991] "s__limicola"
## [992] "s__paradisiaca"
## [993] "s__limneticum"
## [994] "s__hispaniensis"
## [995] "s__sp. P2A-2r"
## [996] "s__indicoceani"
## [997] "s__sp. DBS4"
## [998] "s__sandarakinus"
## [999] "s__sp. JM171"
## [1000] "s__okcheonensis"
## [1001] "s__maricopensis"
## [1002] "s__japonicum"
## [1003] "s__sp. JK5"
## [1004] "s__sp. SCR221107"
## [1005] "s__acidovorans"
## [1006] "s__dalangtanensis"
## [1007] "s__sp. S13"
## [1008] "s__heliothermus"
## [1009] "s__sp. BHT-5-2"
## [1010] "s__portus"
## [1011] "s__algeriensis"
## [1012] "s__taetrolens"
## [1013] "s__sp. nov. GSS16"
## [1014] "s__cyanobacteriivorans"
## [1015] "s__chaffeensis"
## [1016] "s__producta"
## [1017] "s__sp. Minos11"
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## [1018] "s__mesophilus"
## [1019] "s__sp. RS-1"
## [1020] "s__zhanjiangense"
## [1021] "s__sp. B21-038"
## [1022] "s__buccalis"
## [1023] "s__rutgersensis"
## [1024] "s__sp. 5B5"
## [1025] "s__ligni"
## [1026] "s__uliginis"
## [1027] "s__casseliflavus"
## [1028] "s__thermarum"
## [1029] "s__sp. Sym1"
## [1030] "s__sp. HMP9"
## [1031] "s__missouriensis"
## [1032] "s__gelatinilyticus"
## [1033] "s__sp. Q1-7"
## [1034] "s__sp. THAF37"
## [1035] "s__endosymbioticus"
## [1036] "s__aurum"
## [1037] "s__bolteae"
## [1038] "s__damnosus"
## [1039] "s__tyrosinosolvens"
## [1040] "s__frequens"
## [1041] "s__irradiatisoli"
## [1042] "s__sp. HDW6A"
## [1043] "s__arcticum"
## [1044] "s__sp. CdTB01"
## [1045] "s__massiliensis"
## [1046] "s__garamanticum"
## [1047] "s__tundrae"
## [1048] "s__qintianiae"
## [1049] "s__seeligeri"
## [1050] "s__ytuae"
## [1051] "s__sp. SSM4.3"
## [1052] "s__groenlandica"
## [1053] "s__oleilytica"
## [1054] "s__oxydans"
## [1055] "s__dichloroeliminans"
## [1056] "s__formosensis"
## [1057] "s__sp. KNUC1026"
## [1058] "s__apis"
## [1059] "s__zhujimingii"
## [1060] "s__peruense"
## [1061] "s__sp. Y1"
## [1062] "s__potus"
## [1063] "s__sp. DSM 9736"
## [1064] "s__sp. NBC_00162"
## [1065] "s__homolactica"
## [1066] "s__rhizosphaerae"
## [1067] "s__brevitalea"
## [1068] "s__ayderensis"
## [1069] "s__oris"
## [1070] "s__sp. VKM Ac-2801"
## [1071] "s__sp. C6131"
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## [1072] "s__vesicularis"
## [1073] "s__frankenforstense"
## [1074] "s__sp. HDW14"
## [1075] "s__sp. B1ASS3"
## [1076] "s__roodepoortensis"
## [1077] "s__saccharobutylicum"
## [1078] "s__coccineus"
## [1079] "s__sp. NLF-1-9"
## [1080] "s__actiniarum"
## [1081] "s__sp. FeAm09"
## [1082] "s__sp. NBC37-1"
## [1083] "s__sp. RD1"
## [1084] "s__sp. PAMC25046"
## [1085] "s__sp. MNS18"
## [1086] "s__sp. WMMD1128"
## [1087] "s__tibetensis"
## [1088] "s__toxicus"
## [1089] "s__freundii"
## [1090] "s__sp. PET-29"
## [1091] "s__erythreum"
## [1092] "s__hydrogenophilus"
## [1093] "s__sp. NW-56"
## [1094] "s__graminis"
## [1095] "s__alba"
## [1096] "s__aubagnense"
## [1097] "s__sp. MOE7"
## [1098] "s__sp. CCGE-LA001"
## [1099] "s__sp. 113-1-2"
## [1100] "s__sp. AWRP"
## [1101] "s__sp. YH-1"
## [1102] "s__sp. NIES-4073"
## [1103] "s__sp. NB0720_010"
## [1104] "s__roseochromogenus"
## [1105] "s__curvatus"
## [1106] "s__fuchuensis"
## [1107] "s__lavamentivorans"
## [1108] "s__fastidiosum"
## [1109] "s__cashew"
## [1110] "s__salina"
## [1111] "s__sp. GAS231"
## [1112] "s__ciconiae"
## [1113] "s__sp. E85"
## [1114] "s__aliiformigenes"
## [1115] "s__sp. SGAir0570"
## [1116] "s__quebecense"
## [1117] "s__nitroreducens"
## [1118] "s__harbinensis"
## [1119] "s__maccroryi"
## [1120] "s__horikoshii"
## [1121] "s__crossotus"
## [1122] "s__sp. PA-3-X8"
## [1123] "s__abyssicola"
## [1124] "s__sp. L5"
## [1125] "s__nonliquefaciens"
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## [1126] "s__sp. LL1"
## [1127] "s__sp. I3-3-89"
## [1128] "s__pulmonis"
## [1129] "s__sp. NJN-50"
## [1130] "s__genomosp. 1"
## [1131] "s__spinosa"
## [1132] "s__sp. TN58"
## [1133] "s__sp. SL48"
## [1134] "s__sp. GAS493"
## [1135] "s__extremaustralis"
## [1136] "s__delbrueckii"
## [1137] "s__aquilus"
## [1138] "s__sp. ALW1"
## [1139] "s__animalis"
## [1140] "s__aureus"
## [1141] "s__hyodysenteriae"
## [1142] "s__sp. FD7"
## [1143] "s__sp. KACC 21273"
## [1144] "s__sp. FJAT-53532"
## [1145] "s__daphniae"
## [1146] "s__rouxii"
## [1147] "s__quasivariicola"
## [1148] "s__sp. S8"
## [1149] "s__atlanticus"
## [1150] "s__persephone"
## [1151] "s__alni"
## [1152] "s__eutactus"
## [1153] "s__rhizophila"
## [1154] "s__caeruleus"
## [1155] "s__sp. BIHB 4019"
## [1156] "s__fascians"
## [1157] "s__hampsonii"
## [1158] "s__sp. MA"
## [1159] "s__sp. SYP-A7193"
## [1160] "s__tundricola"
## [1161] "s__aeolianus"
## [1162] "s__oralis"
## [1163] "s__daejeonensis"
## [1164] "s__atlantica"
## [1165] "s__coeruleorubidus"
## [1166] "s__sp. mosi_1"
## [1167] "s__kubicae"
## [1168] "s__rubi"
## [1169] "s__sp. CA-293567"
## [1170] "s__sp. Hama-1"
## [1171] "s__ossetica"
## [1172] "s__sp. SL4(2022)"
## [1173] "s__johnsonii"
## [1174] "s__sp. ZF2019"
## [1175] "s__sp. J223"
## [1176] "s__fragariae"
## [1177] "s__sp. N1-1"
## [1178] "s__megalosphaeroides"
## [1179] "s__fungicidicus"
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## [1180] "s__tuberculostearicum"
## [1181] "s__sp. CBA3647"
## [1182] "s__sp. IIBBL 290-4"
## [1183] "s__salinus"
## [1184] "s__sp. AM1P"
## [1185] "s__otitidiscaviarum"
## [1186] "s__sp. DG15C"
## [1187] "s__genomosp. 9"
## [1188] "s__antarcticus"
## [1189] "s__glucuronolyticum"
## [1190] "s__calidifontis"
## [1191] "s__kilaueensis"
## [1192] "s__sp. BJA-103"
## [1193] "s__kivui"
## [1194] "s__thiophilum"
## [1195] "s__sp. I52.16.1"
## [1196] "s__kefiranofaciens"
## [1197] "s__garvieae"
## [1198] "s__sp. Crenshaw"
## [1199] "s__jordaniae"
## [1200] "s__sp. CCBAU 051011"
## [1201] "s__pretiosum"
## [1202] "s__coralli"
## [1203] "s__sp. XCS3"
## [1204] "s__sp. JZ16"
## [1205] "s__sp. SD17-2"
## [1206] "s__sp. ZC-3"
## [1207] "s__sp. WL3"
## [1208] "s__fergusonii"
## [1209] "s__viridis"
## [1210] "s__[Ruminococcus] torques"
## [1211] "s__californiensis"
## [1212] "s__sp. S132"
## [1213] "s__violaceinigra"
## [1214] "s__sp. SCLZS86"
## [1215] "s__baarsii"
## [1216] "s__corrugata"
## [1217] "s__sp. MUD61"
## [1218] "s__eckloniae"
## [1219] "s__tunisiensis"
## [1220] "s__piersonii"
## [1221] "s__ganghwensis"
## [1222] "s__sp. BPTC-684"
## [1223] "s__paraseoulense"
## [1224] "s__glumae"
## [1225] "s__protegens"
## [1226] "s__pituitosa"
## [1227] "s__sp. PAMC 29334"
## [1228] "s__sp. E13-17"
## [1229] "s__festucae"
## [1230] "s__vaginalis"
## [1231] "s__inquinata"
## [1232] "s__phaseoli"
## [1233] "s__azorensis"
```

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## [1234] "s__sp. SSTM10-2"
## [1235] "s__gallinarum"
## [1236] "s__caoxuetaonis"
## [1237] "s__thiooxydans"
## [1238] "s__sp. WMMD882"
## [1239] "s__sp. CBW1107"
## [1240] "s__fakonensis"
## [1241] "s__anthropi"
## [1242] "s__sp. URB8-2"
## [1243] "s__omphalii"
## [1244] "s__yanjiei"
## [1245] "s__sp. LMS18"
## [1246] "s__pulveris"
## [1247] "s__kefiri"
## [1248] "s__chromogenes"
## [1249] "s__sp. THAF27"
## [1250] "s__sp. JQ2195"
## [1251] "s__palmae"
## [1252] "s__sp. AL041005-10"
## [1253] "s__albata"
## [1254] "s__sp. 9128"
## [1255] "s__testudinoris"
## [1256] "s__paneuropaeus"
## [1257] "s__paraterrae"
## [1258] "s__pickettii"
## [1259] "s__aminophilus"
## [1260] "s__hydrolyticus"
## [1261] "s__sp. W027"
## [1262] "s__entomophilus"
## [1263] "s__kaempferiae"
## [1264] "s__sp. PCC 7116"
## [1265] "s__sp. FSL R7-0331"
## [1266] "s__xylosus"
## [1267] "s__sp. SMJS2"
## [1268] "s__nantongensis"
## [1269] "s__sp. G0186"
## [1270] "s__pseudoflava"
## [1271] "s__sp. SCSIO W0465"
## [1272] "s__lovleyi"
## [1273] "s__mediterranea"
## [1274] "s__baratii"
## [1275] "s__liquefaciens"
## [1276] "s__donggukensis"
## [1277] "s__borealis"
## [1278] "s__asparagiformis"
## [1279] "s__antimycoticus"
## [1280] "s__tanashiensis"
## [1281] "s__salivarius"
## [1282] "s__turgidum"
## [1283] "s__xanthii"
## [1284] "s__sp. OE 28.3"
## [1285] "s__sphenoides"
## [1286] "s__albidiflava"
## [1287] "s__pudoricolor"
```

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## [1288] "s__sp. SCSIO W1103"
## [1289] "s__angustmyceticus"
## [1290] "s__agamarum"
## [1291] "s__alginolyticus"
## [1292] "s__sp. THN1"
## [1293] "s__africae"
## [1294] "s__umbonata"
## [1295] "s__radiopugnans"
## [1296] "s__arsenatis"
## [1297] "s__sp. JC009"
## [1298] "s__apisilvae"
## [1299] "s__sp. CCMP332"
## [1300] "s__sacchari"
## [1301] "s__succinogenes"
## [1302] "s__buecherae"
## [1303] "s__sp. NA04385"
## [1304] "s__sp. M2A.F.Ca.ET.043.05.1.1"
## [1305] "s__sp. GAM44"
## [1306] "s__varigena"
## [1307] "s__sp. LV10R510-11A"
## [1308] "s__formigenes"
## [1309] "s__pacaensis"
## [1310] "s__saudimassiliensis"
## [1311] "s__sp. JMULE5"
## [1312] "s__resistens"
## [1313] "s__wenzhouensis"
## [1314] "s__sp. NHP19-003"
## [1315] "s__stercoris"
## [1316] "s__daejeonense"
## [1317] "s__sp. HSG2"
## [1318] "s__sp. NCRR"
## [1319] "s__drozdowiczii"
## [1320] "s__sunyaminii"
## [1321] "s__album"
## [1322] "s__veronii"
## [1323] "s__pulmonicola"
## [1324] "s__sp. LS.1a"
## [1325] "s__sp. 29361"
## [1326] "s__sp. H6"
## [1327] "s__sp. G2S3"
## [1328] "s__sp. SL250"
## [1329] "s__methylotrophus"
## [1330] "s__quasipneumoniae"
## [1331] "s__cyaneogriseus"
## [1332] "s__lloydii"
## [1333] "s__rivuli"
## [1334] "s__sp. NIES-4102"
## [1335] "s__degradans"
## [1336] "s__riograndensis"
## [1337] "s__baixiangningiae"
## [1338] "s__sp. 107-1"
## [1339] "s__tritici"
## [1340] "s__sp. BT-42-2"
## [1341] "s__paurometabola"
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## [1342] "s__cloacae"
## [1343] "s__warabiya"
## [1344] "s__nigra"
## [1345] "s__sp. BT-123"
## [1346] "s__faecium"
## [1347] "s__phenanthrenivorans"
## [1348] "s__sp. WAC00303"
## [1349] "s__sp. XGS-02"
## [1350] "s__sp. ArI3"
## [1351] "s__carbinoliphilus"
## [1352] "s__mucilaginosus"
## [1353] "s__sp. 'Peltigera membranacea cyanobiont' N6"
## [1354] "s__thermosuccinogenes"
## [1355] "s__haemolysans"
## [1356] "s__elongata"
## [1357] "s__sp. NBH87"
## [1358] "s__espanaensis"
## [1359] "s__portucalensis"
## [1360] "s__alkalisoli"
## [1361] "s__paucimobilis"
## [1362] "s__sp. Pc102"
## [1363] "s__magna"
## [1364] "s__sp. FDAARGOS 1241"
## [1365] "s__Candidatus Protofrankia datiscae"
## [1366] "s__bogorensis"
## [1367] "s__somerae"
## [1368] "s__xylosoxidans"
## [1369] "s__indicus"
## [1370] "s__hominis"
## [1371] "s__dysgalactiae"
## [1372] "s__sp. LQ25"
## [1373] "s__sp. RTd22"
## [1374] "s__sp. Jing01"
## [1375] "s__brasiliense"
## [1376] "s__allomyrinae"
## [1377] "s__azurea"
## [1378] "s__baculatum"
## [1379] "s__phytophila"
## [1380] "s__yayanosii"
## [1381] "s__sp. DH3716P"
## [1382] "s__sp. BT-177"
## [1383] "s__aminovorans"
## [1384] "s__sp. F8"
## [1385] "s__pacifica"
## [1386] "s__thiotaurini"
## [1387] "s__goodwinii"
## [1388] "s__haemolytica"
## [1389] "s__[Ochrobactrum] quorumnocens"
## [1390] "s__promysalinigenes"
## [1391] "s__sp. CC9605"
## [1392] "s__metalliredigens"
## [1393] "s__plymuthica"
## [1394] "s__sp. Tan611"
## [1395] "s__sp. LRE541"
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## [1396] "s__urogenitale"
## [1397] "s__sp. RC67"
## [1398] "s__sp. M166"
## [1399] "s__liliifuscus"
## [1400] "s__cholerae"
## [1401] "s__flocculans"
## [1402] "s__sp. SAU14A_NAIMI4_5"
## [1403] "s__sp. ZJ106"
## [1404] "s__syringae group genomosp. 7"
## [1405] "s__telluris"
## [1406] "s__terrenum"
## [1407] "s__konosiri"
## [1408] "s__equorum"
## [1409] "s__sp. JZB09"
## [1410] "s__sp. CNQ-509"
## [1411] "s__rotundus"
## [1412] "s__lablabi"
## [1413] "s__glycaniphila"
## [1414] "s__sp. SO1"
## [1415] "s__aromatica"
## [1416] "s__sp. Colony194"
## [1417] "s__caseolyticus"
## [1418] "s__sp. CZR27"
## [1419] "s__osloensis"
## [1420] "s__intracellularis"
## [1421] "s__fallax"
## [1422] "s__bifermentans"
## [1423] "s__sp. 5413J-13"
## [1424] "s__sp. SK50-23"
## [1425] "s__acetigenes"
## [1426] "s__chauvoei"
## [1427] "s__venezuelae"
## [1428] "s__sp. WAC 01438"
## [1429] "s__arginini"
## [1430] "s__oryzicola"
## [1431] "s__aureoverticillatus"
## [1432] "s__sp. QY071"
## [1433] "s__sp. SG1"
## [1434] "s__versatilis"
## [1435] "s__sp. WMMD812"
## [1436] "s__sp. SA4125"
## [1437] "s__albus"
## [1438] "s__sulfuroxidans"
## [1439] "s__baengnokdamensis"
## [1440] "s__allii"
## [1441] "s__sp. OT7"
## [1442] "s__sp. FDAARGOS 1409"
## [1443] "s__urinaehominis"
## [1444] "s__sp. OxB-1"
## [1445] "s__sp. Bac332"
## [1446] "s__abscessus"
## [1447] "s__sp. JM1"
## [1448] "s__nigripulchritudo"
## [1449] "s__sp. M30-35"
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## [1450] "s__methanolica"
## [1451] "s__sp. MR_MD2014"
## [1452] "s__sp. YPW1"
## [1453] "s__phytofermentans"
## [1454] "s__sp. HUAS 15-9"
## [1455] "s__[Clostridium] colinum"
## [1456] "s__sp. 113P3"
## [1457] "s__chenweiae"
## [1458] "s__metallilatus"
## [1459] "s__hygroscopicus"
## [1460] "s__penaei"
## [1461] "s__sp. CX169"
## [1462] "s__coccoides"
## [1463] "s__guangzhouensis"
## [1464] "s__arabaticum"
## [1465] "s__sp. PAMC26645"
## [1466] "s__sp. VKM Ac-2759"
## [1467] "s__pnomenusa"
## [1468] "s__pseudoxylosus"
## [1469] "s__singaporensis"
## [1470] "s__ferrireducens"
## [1471] "s__sp. NFH-SH190041"
## [1472] "s__chenwenguii"
## [1473] "s__sp. QL22"
## [1474] "s__autotrophicum"
## [1475] "s__lutrae"
## [1476] "s__lunaelactis"
## [1477] "s__phocaeense"
## [1478] "s__alcaligenes"
## [1479] "s__aquatilis"
## [1480] "s__litorale"
## [1481] "s__sp. NSJ-69"
## [1482] "s__cervicalis"
## [1483] "s__sp. IMCC11727"
## [1484] "s__aquaemixtae"
## [1485] "s__xylanophilus"
## [1486] "s__americana"
## [1487] "s__caseinilytica"
## [1488] "s__vulnificus"
## [1489] "s__cinaedi"
## [1490] "s__rimosus"
## [1491] "s__oleovorans"
## [1492] "s__novyi"
## [1493] "s__sp. G2-5"
## [1494] "s__sp. XC 2026"
## [1495] "s__kimnyeongensis"
## [1496] "s__kermanshahensis"
## [1497] "s__sp. oral taxon 218"
## [1498] "s__brandeum"
## [1499] "s__iranensis"
## [1500] "s__similis"
## [1501] "s__japonica"
## [1502] "s__antibioticus"
## [1503] "s__mucosae"
```

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## [1504] "s__sp. INOP01"
## [1505] "s__piscicola"
## [1506] "s__uncultured bacterium"
## [1507] "s__sp. CY52-2"
## [1508] "s__sp. WL1"
## [1509] "s__echinospora"
## [1510] "s__opportunistum"
## [1511] "s__sp. Z423-1"
## [1512] "s__arabiense"
## [1513] "s__dextrinosolvens"
## [1514] "s__gottheilii"
## [1515] "s__lizhenjunii"
## [1516] "s__avenae"
## [1517] "s__actuosus"
## [1518] "s__sp. Bac330"
## [1519] "s__sp. D2"
## [1520] "s__cellulans"
## [1521] "s__xylaniphila"
## [1522] "s__phagedenis"
## [1523] "s__brevissima"
## [1524] "s__ignavus"
## [1525] "s__microaerophilus"
## [1526] "s__halocryophilus"
## [1527] "s__avicenniae"
## [1528] "s__sprentiae"
## [1529] "s__sp. PIV-1"
## [1530] "s__sp. FDAARGOS_375"
## [1531] "s__sp. WB-2"
## [1532] "s__fusca"
## [1533] "s__tanakiae"
## [1534] "s__sp. MEDNS5"
## [1535] "s__chagasii"
## [1536] "s__innocua"
## [1537] "s__pinensis"
## [1538] "s__sinuspersici"
## [1539] "s__cowanii"
## [1540] "s__rhodesiae"
## [1541] "s__sp. 336/3"
## [1542] "s__pectinilyticus"
## [1543] "s__tenebrarum"
## [1544] "s__richardii"
## [1545] "s__candidum"
## [1546] "s__sp. CBA3606"
## [1547] "s__temperans"
## [1548] "s__tolaasii"
## [1549] "s__violaceusniger"
## [1550] "s__sp. LG1267"
## [1551] "s__sp. KACC 23028"
## [1552] "s__atlantisensis"
## [1553] "s__fredii"
## [1554] "s__sp. WH 8020"
## [1555] "s__sp. M6A.T.Cr.TU.016.01.1.1"
## [1556] "s__sp. NRS527"
## [1557] "s__sobrinus"
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## [1558] "s__alleghenense"
## [1559] "s__vicinigordonae"
## [1560] "s__sp. YPD9-1"
## [1561] "s__pumilum"
## [1562] "s__lithotrophicum"
## [1563] "s__ectocarpi"
## [1564] "s__sp. Y32M11"
## [1565] "s__toyakuensis"
## [1566] "s__phaeovibrioides"
## [1567] "s__sp. 3H"
## [1568] "s__sp. S1D4-14"
## [1569] "s__sp. CKK8"
## [1570] "s__lilanjuaniae"
## [1571] "s__sp. YG1"
## [1572] "s__acetoxydans"
## [1573] "s__sp. Hal144"
## [1574] "s__sp. AM 2-1-1"
## [1575] "s__delphini"
## [1576] "s__sp. CCB-MM3"
## [1577] "s__malmoense"
## [1578] "s__sp. OPL5"
## [1579] "s__olearia"
## [1580] "s__clausii"
## [1581] "s__brachiatum"
## [1582] "s__eggerthii"
## [1583] "s__sp. ZY201224"
## [1584] "s__sp. THAF30"
## [1585] "s__influenzae"
## [1586] "s__sp. S6"
## [1587] "s__axanthum"
## [1588] "s__sp. HBX-1"
## [1589] "s__sp. AH1"
## [1590] "s__towneri"
## [1591] "s__flexa"
## [1592] "s__tuirus"
## [1593] "s__faecalis"
## [1594] "s__sp. Go-475"
## [1595] "s__ratti"
## [1596] "s__sp. St316"
## [1597] "s__pseudogrignonensis"
## [1598] "s__Blochmannia endosymbiont of Polyrhachis (Hedomyrma) turneri"
## [1599] "s__tractuosa"
## [1600] "s__sp. HKU1"
## [1601] "s__ferriphilum"
## [1602] "s__damselae"
## [1603] "s__media"
## [1604] "s__Enterobacteriaceae endosymbiont of Donacia tomentosa"
## [1605] "s__panamensis"
## [1606] "s__carniphilus"
## [1607] "s__methoxysyntrophicus"
## [1608] "s__capnotolerans"
## [1609] "s__diazotrophicus"
## [1610] "s__sp. SL47"
## [1611] "s__phosphovorus"
```

```
## [1612] "s__vincentii"
## [1613] "s__sp. M41"
## [1614] "s__sp. WS11"
## [1615] "s__sp. G01H"
## [1616] "s__simplex"
## [1617] "s__hydrophila"
## [1618] "s__aidingensis"
## [1619] "s__thermoresistibile"
## [1620] "s__sp. BPS33"
## [1621] "s__brasilensis"
## [1622] "s__sp. E15-22"
## [1623] "s__jaguaris"
## [1624] "s__phocoenae"
## [1625] "s__vanderleydeniana"
## [1626] "s__sp. LM7"
## [1627] "s__zhachilii"
## [1628] "s__sp. 63ED37-2"
## [1629] "s__cytotoxicus"
## [1630] "s__saxobsidens"
## [1631] "s__terrigena"
## [1632] "s__sp. H121"
## [1633] "s__daltonii"
## [1634] "s__pediculischaeffi"
## [1635] "s__aquaticum"
## [1636] "s__humicireducens"
## [1637] "s__genisteinicus"
## [1638] "s__sp. PMCC200344"
## [1639] "s__pentosaceus"
## [1640] "s__phocisimile"
## [1641] "s__sp. CCB-ST2H9"
## [1642] "s__degensii"
## [1643] "s__sp. B32"
## [1644] "s__jordanis"
## [1645] "s__warneri"
## [1646] "s__sp. PCC 7327"
## [1647] "s__ammonigenes"
## [1648] "s__blattae"
## [1649] "s__wieringae"
## [1650] "s__cavernae"
## [1651] "s__medellinensis"
## [1652] "s__tardum"
## [1653] "s__crateris"
## [1654] "s__senegalensis"
## [1655] "s__paucivorans"
## [1656] "s__megapolitana"
## [1657] "s__sp. WMMD987"
## [1658] "s__botulinum"
## [1659] "s__composti"
## [1660] "s__sp. 1566"
## [1661] "s__orientale"
## [1662] "s__sp. MTM4"
## [1663] "s__auricularis"
## [1664] "s__hongtaonis"
## [1665] "s__monticola"
```

```
## [1666] "s__sp. MC1825"
## [1667] "s__incomptus"
## [1668] "s__lactatiformans"
## [1669] "s__pukyongi"
## [1670] "s__stabekisii"
## [1671] "s__pantholopis"
## [1672] "s__multitudinisentens"
## [1673] "s__sp. No. 7"
## [1674] "s__urinaeequi"
## [1675] "s__sp. P6W"
## [1676] "s__nojiriensis"
## [1677] "s__vibrioformis"
## [1678] "s__tructae"
## [1679] "s__sp. AM 4-1-1"
## [1680] "s__lichenicola"
## [1681] "s__Verrucosispora sp. WMMD1129"
## [1682] "s__sp. AGMB13025"
## [1683] "s__hwasookii"
## [1684] "s__bohemicus"
## [1685] "s__lividus"
## [1686] "s__minnesotensis"
## [1687] "s__nucleatum"
## [1688] "s__paludicola"
## [1689] "s__fermenticellae"
## [1690] "s__heliotrinireducens"
## [1691] "s__sp. JS3050"
## [1692] "s__[Acidovorax] ebreus"
## [1693] "s__furrinae"
## [1694] "s__sp. QJXJ"
## [1695] "s__verrucosospora"
## [1696] "s__rhamnosivorans"
## [1697] "s__carboxydovora"
## [1698] "s__barranii"
## [1699] "s__callanderi"
## [1700] "s__capsulatus"
## [1701] "s__aerodenitrificans"
## [1702] "s__griseus"
## [1703] "s__tertiaricarbonis"
## [1704] "s__sera"
## [1705] "s__pseudogenitalium"
## [1706] "s__azadirachtae"
## [1707] "s__sp. WMMD998"
## [1708] "s__sp. MI1205"
## [1709] "s__felsineum"
## [1710] "s__sp. GDN1"
## [1711] "s__sp. M28"
## [1712] "s__clevelandensis"
## [1713] "s__sp. MB-3u-03"
## [1714] "s__sp. 116-D4"
## [1715] "s__sp. BIM B-2242"
## [1716] "s__sp. HF-162"
## [1717] "s__tubbatahanensis"
## [1718] "s__sp. RPA4-2"
## [1719] "s__anaerobius"
```

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## [1720] "s__sp. 8"
## [1721] "s__halichoeri"
## [1722] "s__sp. ZAC14D1_NAIMI4_6"
## [1723] "s__asoensis"
## [1724] "s__sp. 'AMD consortium'"
## [1725] "s__sp. NIV53"
## [1726] "s__lydicamycinicus"
## [1727] "s__fuliginis"
## [1728] "s__phasianinus"
## [1729] "s__sp. XAAS-72"
## [1730] "s__flavescens"
## [1731] "s__alvei"
## [1732] "s__sp. ZS1"
## [1733] "s__aeria"
## [1734] "s__schaalii"
## [1735] "s__cadmiisoli"
## [1736] "s__sp. 21SJ11W-1"
## [1737] "s__sp. TSA-1"
## [1738] "s__endophyticus"
## [1739] "s__argentoratense"
## [1740] "s__setae"
## [1741] "s__chenwenxiniae"
## [1742] "s__natronophila"
## [1743] "s__dafuensis"
## [1744] "s__wolfei"
## [1745] "s__Gramella oceanisediminis"
## [1746] "s__chongii"
## [1747] "s__piniformis"
## [1748] "s__phragmitis"
## [1749] "s__muris"
## [1750] "s__dextrinicus"
## [1751] "s__wiegelii"
## [1752] "s__thermocellus"
## [1753] "s__sp. Z2-YC6860"
## [1754] "s__spormannii"
## [1755] "s__sp. Je 1-4 4N24_ara"
## [1756] "s__sp. H1-D42"
## [1757] "s__hoggarensis"
## [1758] "s__sp. Wsw4-B4"
## [1759] "s__sp. oral taxon 221"
## [1760] "s__sp. ZQ21"
## [1761] "s__sp. WZ-12"
## [1762] "s__sp. EFPC2"
## [1763] "s__sp. LW-XY12"
## [1764] "s__roseum"
## [1765] "s__sp. CBA3646"
## [1766] "s__sp. BAB1"
## [1767] "s__sp. LM2"
## [1768] "s__sp. FXJ1.172"
## [1769] "s__ferragutiae"
## [1770] "s__novella"
## [1771] "s__ampullae"
## [1772] "s__sp. B7740"
## [1773] "s__sp. LTJR-52"
```

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## [1774] "s__dubosii"
## [1775] "s__contaminans"
## [1776] "s__sp. UTMC 2448"
## [1777] "s__lusitanus"
## [1778] "s__rubidaea"
## [1779] "s__porci"
## [1780] "s__arctica"
## [1781] "s__sp. KMM 9044"
## [1782] "s__sp. N12"
## [1783] "s__bacteriovorus"
## [1784] "s__jishulii"
## [1785] "s__baekrokdamisoli"
## [1786] "s__sp. TSH58"
## [1787] "s__pseudolwoffii"
## [1788] "s__sp. B01"
## [1789] "s__sp. CENA543"
## [1790] "s__hordei"
## [1791] "s__eutropha"
## [1792] "s__oboediens"
## [1793] "s__sp. LMS25"
## [1794] "s__chonburiensis"
## [1795] "s__sp. BT304"
## [1796] "s__jejuense"
## [1797] "s__caprae"
## [1798] "s__sp. RHB25-C09"
## [1799] "s__sp. NIBR10"
## [1800] "s__ampelinum"
## [1801] "s__thetaiotaomicron"
## [1802] "s__sp. KB-1"
## [1803] "s__sordellii"
## [1804] "s__sp. L6-1"
## [1805] "s__sp. WH15"
## [1806] "s__argentinense"
## [1807] "s__sp. 481"
## [1808] "s__ferus"
## [1809] "s__asymbioticus"
## [1810] "s__sp. JXJ CY 41"
## [1811] "s__sp. (ex Adelges kitamiensis)"
## [1812] "s__alkanivorans"
## [1813] "s__amazonense"
## [1814] "s__sp. SAHP1"
## [1815] "s__sp. JSBI002"
## [1816] "s__fulvum"
## [1817] "s__sp. LG1E9"
## [1818] "s__hexanoica"
## [1819] "s__sp. Arc7-R13"
## [1820] "s__parabuchneri"
## [1821] "s__aridicollis"
## [1822] "s__sp. PP30"
## [1823] "s__pestifer"
## [1824] "s__sp. B21-048"
## [1825] "s__sp. HS6"
## [1826] "s__mangyaensis"
## [1827] "s__corallicola"
```

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## [1828] "s__sp. 1S1"
## [1829] "s__sp. CB01881"
## [1830] "s__elymi"
## [1831] "s__thermoacetica"
## [1832] "s__[Pantoea] beijingensis"
## [1833] "s__sp. ZS110521"
## [1834] "s__maris"
## [1835] "s__sp. JN-9"
## [1836] "s__brockianus"
## [1837] "s__segnis"
## [1838] "s__sanguinicola"
## [1839] "s__silvanus"
## [1840] "s__amylolyticum"
## [1841] "s__kluyveri"
## [1842] "s__sp. G7(2002)"
## [1843] "s__sp. LM1"
## [1844] "s__sp. GW460-12-10-14-LB2"
## [1845] "s__sp. USTB-05"
## [1846] "s__australiense"
## [1847] "s__sp. F9"
## [1848] "s__ramasamyi"
## [1849] "s__sp. S063"
## [1850] "s__sp. ZJ450"
## [1851] "s__sp. ATCC 13867"
## [1852] "s__sp. B11D7D"
## [1853] "s__sp. NEAQ87857"
## [1854] "s__acidipiscis"
## [1855] "s__simulans"
## [1856] "s__faecigallinarum"
## [1857] "s__fabacearum"
## [1858] "s__sp. p52"
## [1859] "s__sp. FSL P4-0081"
## [1860] "s__oryziradicis"
## [1861] "s__sulfidophilum"
## [1862] "s__gengyunqii"
## [1863] "s__murinus"
## [1864] "s__infantarius"
## [1865] "s__sp. CMR5c"
## [1866] "s__cellobiosedens"
## [1867] "s__gelidum"
## [1868] "s__crocodili"
## [1869] "s__praecaptivus"
## [1870] "s__sp. FSL R5-0912"
## [1871] "s__sp. PM"
## [1872] "s__yunnanensis"
## [1873] "s__wiedmannii"
## [1874] "s__herbilytica"
## [1875] "s__sp. P2G3"
## [1876] "s__quintilis"
## [1877] "s__pasteurianus"
## [1878] "s__sp. PCC 7524"
## [1879] "s__sp. SFB-mouse-NL"
## [1880] "s__sp. TT6"
## [1881] "s__sp. oral taxon 136"
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## [1882] "s__sp. RA8"
## [1883] "s__avermitilis"
## [1884] "s__sp. NA04227"
## [1885] "s__mengxianglii"
## [1886] "s__sp. CIB 2401"
## [1887] "s__albidus"
## [1888] "s__gordonii"
## [1889] "s__guangzhouense"
## [1890] "s__adecarboxylata"
## [1891] "s__arthritidis"
## [1892] "s__ovatus"
## [1893] "s__sp. HH130630-07"
## [1894] "s__hattorii"
## [1895] "s__centrodinii"
## [1896] "s__flaccumfaciens"
## [1897] "s__sp. 2114.2"
## [1898] "s__diazoefficiens"
## [1899] "s__beijingensis"
## [1900] "s__lemovicicum"
## [1901] "s__sp. zg-570"
## [1902] "s__onderdonkii"
## [1903] "s__sp. VKM Ac-2804"
## [1904] "s__wuliandei"
## [1905] "s__faecis"
## [1906] "s__sp. PBC"
## [1907] "s__microcystinivorans"
## [1908] "s__sp. K11"
## [1909] "s__sp. Pdp11"
## [1910] "s__sp. PGP41"
## [1911] "s__hydrogeniphila"
## [1912] "s__kobayashii"
## [1913] "s__sp. K5-23"
## [1914] "s__sp. DSM 15011"
## [1915] "s__sp. NBRC 113351"
## [1916] "s__sp. P11F6"
## [1917] "s__xiejunii"
## [1918] "s__iocasae"
## [1919] "s__spirulinae"
## [1920] "s__timorensis"
## [1921] "s__ureae"
## [1922] "s__mexicanum"
## [1923] "s__akajimensis"
## [1924] "s__pernigra"
## [1925] "s__cystitidis"
## [1926] "s__sp. L1I39"
## [1927] "s__pacificus"
## [1928] "s__aegosomatis"
## [1929] "s__filamentosus"
## [1930] "s__pseudonitzschiae"
## [1931] "s__sp. 24S4-2"
## [1932] "s__sp. AMCC400023"
## [1933] "s__anaerobium"
## [1934] "s__kanasensis"
## [1935] "s__solisilvae"
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## [1936] "s__ficellus"
## [1937] "s__alfacsensis"
## [1938] "s__sp. MM211"
## [1939] "s__terrestris"
## [1940] "s__sp. LM091"
## [1941] "s__psychrophila"
## [1942] "s__solanacearum"
## [1943] "s__sp. 391_Methyba4"
## [1944] "s__matsuzakiense"
## [1945] "s__crocodyli"
## [1946] "s__sp. (ex Biomphalaria glabrata)"
## [1947] "s__orenii"
## [1948] "s__sp. MMS21-STM26"
## [1949] "s__ihumii"
## [1950] "s__morganii"
## [1951] "s__guodeyinii"
## [1952] "s__yudongzhengii"
## [1953] "s__sp. L9-4"
## [1954] "s__endosymbiont of Aphis craccivora"
## [1955] "s__Candidatus Erwinia haradaeae"
## [1956] "s__wasabiae"
## [1957] "s__sp. YRD-M1"
## [1958] "s__marinisabuli"
## [1959] "s__euroxanthea"
## [1960] "s__marensis"
## [1961] "s__moniliformis"
## [1962] "s__oleronia"
## [1963] "s__sp. A18JL241"
## [1964] "s__aquatica"
## [1965] "s__sp. YGSMI21"
## [1966] "s__deccanensis"
## [1967] "s__griseochromogenes"
## [1968] "s__sp. FF17"
## [1969] "s__bovirhinis"
## [1970] "s__sp. BH-2-1-1"
## [1971] "s__amylovora"
## [1972] "s__sp. H12"
## [1973] "s__urinae"
## [1974] "s__limnaeum"
## [1975] "s__abyssalis"
## [1976] "s__xanthus"
## [1977] "s__aespoeensis"
## [1978] "s__sp. SGAir0440"
## [1979] "s__formicigenerans"
## [1980] "s__saurashtrense"
## [1981] "s__sp. ESL0704"
## [1982] "s__vinelandii"
## [1983] "s__huttiense"
## [1984] "s__dongpingensis"
## [1985] "s__sp. SS4"
## [1986] "s__sp. 3AFRM03"
## [1987] "s__subtropicus"
## [1988] "s__sambongensis"
## [1989] "s__sp. G11"
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## [1990] "s__sp. SCSIO 43209"
## [1991] "s__catena"
## [1992] "s__fodineus"
## [1993] "s__sp. AB2/73"
## [1994] "s__sp. MYC340"
## [1995] "s__mannosilyticum"
## [1996] "s__sp. Rep29"
## [1997] "s__ethanolicus"
## [1998] "s__junii"
## [1999] "s__herbicidovorans"
## [2000] "s__canadensis"
## [2001] "s__rugosus"
## [2002] "s__elgii"
## [2003] "s__humireducens"
## [2004] "s__sp. KBS0714"
## [2005] "s__myxofaciens"
## [2006] "s__veroralis"
## [2007] "s__hortorum"
## [2008] "s__cerasi"
## [2009] "s__globisporus"
## [2010] "s__erythraea"
## [2011] "s__fastidiosa"
## [2012] "s__yamanashiensis"
## [2013] "s__sp. ATCC 53434"
## [2014] "s__australiensis"
## [2015] "s__sp. ORS 278"
## [2016] "s__thalpophilum"
## [2017] "s__sp. DD4"
## [2018] "s__paradoxus"
## [2019] "s__yeei"
## [2020] "s__etheniformans"
## [2021] "s__luteolum"
## [2022] "s__sp. 71268"
## [2023] "s__aureofaciens"
## [2024] "s__gracilis"
## [2025] "s__xylanilyticum"
## [2026] "s__miscanthi"
## [2027] "s__formicaceticum"
## [2028] "s__luteoviolacea"
## [2029] "s__sp. PSBB021"
## [2030] "s__beveridgei"
## [2031] "s__gregorii"
## [2032] "s__seonyuensis"
## [2033] "s__chlorophenolicus"
## [2034] "s__cremea"
## [2035] "s__sp. 1513"
## [2036] "s__sp. LGH"
## [2037] "s__sp. 2017"
## [2038] "s__fallonii"
## [2039] "s__agalactiae"
## [2040] "s__canis"
## [2041] "s__nodulans"
## [2042] "s__sp. M9A.F.Ca.ET.002.03.1.2"
## [2043] "s__mendocina"
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## [2044] "s__toyohensis"
## [2045] "s__propionicigenes"
## [2046] "s__gephyra"
## [2047] "s__muelleri"
## [2048] "s__aminofermentans"
## [2049] "s__genomosp. 13"
## [2050] "s__stygius"
## [2051] "s__sp. Dgby_cultured_2"
## [2052] "s__glycinis"
## [2053] "s__arsenicus"
## [2054] "s__sp. Marseille-Q4369"
## [2055] "s__sp. USDA-ARS-USMARC-1261"
## [2056] "s__marisgermanici"
## [2057] "s__lari"
## [2058] "s__mongolicus"
## [2059] "s__tengchongensis"
## [2060] "s__gordoniae"
## [2061] "s__stantonii"
## [2062] "s__pallida"
## [2063] "s__megaguti"
## [2064] "s__cellulosilyticus"
## [2065] "s__sp. zg-Y815"
## [2066] "s__sp. I2-3-92"
## [2067] "s__validum"
## [2068] "s__ceratoperidinii"
## [2069] "s__sp. AN-B15"
## [2070] "s__nassauensis"
## [2071] "s__sp. ES.047"
## [2072] "s__brasiliensis"
## [2073] "s__colihominis"
## [2074] "s__xylanolyticum"
## [2075] "s__maltosivorans"
## [2076] "s__sp. SO9"
## [2077] "s__sp. IMCC34515"
## [2078] "s__endosymbiont of Folsomia candida"
## [2079] "s__sp. NIC1"
## [2080] "s__rhapontici"
## [2081] "s__sp. SL43"
## [2082] "s__sp. PHS-Z3"
## [2083] "s__sp. SGAir0207"
## [2084] "s__potens"
## [2085] "s__coleopterorum"
## [2086] "s__jejuensis"
## [2087] "s__sp. CIAT894"
## [2088] "s__sp. SL257"
## [2089] "s__sp. CBW1006"
## [2090] "s__sp. GSS18"
## [2091] "s__qinghaiensis"
## [2092] "s__taeniosporum"
## [2093] "s__glucosotrophus"
## [2094] "s__sp. SUR17"
## [2095] "s__sp. HM134"
## [2096] "s__rhizovicinus"
## [2097] "s__aceticum"
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## [2098] "s__cadaveris"
## [2099] "s__sp. K"
## [2100] "s__versutus"
## [2101] "s__sp. J8"
## [2102] "s__navarrensis"
## [2103] "s__amphilecti"
## [2104] "s__sp. zg-629"
## [2105] "s__mucilyticum"
## [2106] "s__triazinivorans"
## [2107] "s__sp. dk2585"
## [2108] "s__equikiangi"
## [2109] "s__caulinodans"
## [2110] "s__lalkuanensis"
## [2111] "s__Candidatus Thiothrix anitrata"
## [2112] "s__vesiculosa"
## [2113] "s__pleomorphus"
## [2114] "s__sp. CBA3108"
## [2115] "s__fodinaquatile"
## [2116] "s__dangxiongensis"
## [2117] "s__exigua"
## [2118] "s__termitida"
## [2119] "s__laidlawii"
## [2120] "s__sp. H4-D48"
## [2121] "s__vulgatus"
## [2122] "s__caniscabiei"
## [2123] "s__sp. TXMA1"
## [2124] "s__sp. A7"
## [2125] "s__sp. CJ23"
## [2126] "s__sp. 18071143"
## [2127] "s__sp. wino2"
## [2128] "s__frisingense"
## [2129] "s__paralvei"
## [2130] "s__sp. HKS02"
## [2131] "s__sp. ZHDP1"
## [2132] "s__byssophila"
## [2133] "s__sp. CD1"
## [2134] "s__periodonticum"
## [2135] "s__sp. Ost2"
## [2136] "s__chartreusis"
## [2137] "s__uberis"
## [2138] "s__sp. Csp2"
## [2139] "s__sp. RtIB026"
## [2140] "s__parauberis"
## [2141] "s__campi"
## [2142] "s__koyamae"
## [2143] "s__casei"
## [2144] "s__sp. MC1865"
## [2145] "s__cacticida"
## [2146] "s__sp. 628"
## [2147] "s__sp. S3-43"
## [2148] "s__sp. T1"
## [2149] "s__acticola"
## [2150] "s__sp. WMMD937"
## [2151] "s__cibarius"
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## [2152] "s__pleomorpha"
## [2153] "s__sp. LX10"
## [2154] "s__cynanchi"
## [2155] "s__antarcticum"
## [2156] "s__lushaniae"
## [2157] "s__dendritiformis"
## [2158] "s__iniae"
## [2159] "s__daqingense"
## [2160] "s__ungokensis"
## [2161] "s__noursei"
## [2162] "s__saprophyticus"
## [2163] "s__sp. LH3U1"
## [2164] "s__choerinum"
## [2165] "s__sp. 7M"
## [2166] "s__sp. KY5"
## [2167] "s__sp. KGMB00164"
## [2168] "s__gotjawali"
## [2169] "s__sediminicola"
## [2170] "s__bialowiezensis"
## [2171] "s__zhangjianzhongii"
## [2172] "s__alkalescens"
## [2173] "s__elenkinii"
## [2174] "s__sp. FJAT-18017"
## [2175] "s__sp. N4-1P"
## [2176] "s__syzygii"
## [2177] "s__sp. FARSPH"
## [2178] "s__sp. 769"
## [2179] "s__abundans"
## [2180] "s__sp. DZFXJ 01"
## [2181] "s__smegmatis"
## [2182] "s__qinzhouensis"
## [2183] "s__alboflavus"
## [2184] "s__eligens"
## [2185] "s__goriensis"
## [2186] "s__congregatus"
## [2187] "s__kitaharae"
## [2188] "s__atypicum"
## [2189] "s__oreochromis"
## [2190] "s__phototrophica"
## [2191] "s__sp. JX0631"
## [2192] "s__porticola"
## [2193] "s__communis"
## [2194] "s__grayi"
## [2195] "s__tracheiphila"
## [2196] "s__sp. TJ11"
## [2197] "s__subterranea"
## [2198] "s__himalayensis"
## [2199] "s__foliorum"
## [2200] "s__sp. UKPF54-2"
## [2201] "s__madurae"
## [2202] "s__namhicola"
## [2203] "s__rubra"
## [2204] "s__liangguodongii"
## [2205] "s__sp. A15-44"
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## [2206] "s__porcinus"
## [2207] "s__badenianii"
## [2208] "s__europaea"
## [2209] "s__sp. L-A4"
## [2210] "s__sp. F-70"
## [2211] "s__sp. HU2014"
## [2212] "s__sp. ID03"
## [2213] "s__hydrocarbonoxydans"
## [2214] "s__jilunlii"
## [2215] "s__sp. G1-14"
## [2216] "s__guizhouensis"
## [2217] "s__magneticus"
## [2218] "s__jeddahense"
## [2219] "s__sp. WD16"
## [2220] "s__corporis"
## [2221] "s__maritima"
## [2222] "s__heidelbergense"
## [2223] "s__sp. TAC-1"
## [2224] "s__madagascariense"
## [2225] "s__arenosus"
## [2226] "s__sp. cx-173"
## [2227] "s__pneumoniae"
## [2228] "s__sp. TF02-10"
## [2229] "s__sp. A64"
## [2230] "s__yangpuensis"
## [2231] "s__briensis"
## [2232] "s__sp. DL592"
## [2233] "s__sp. BJN0001"
## [2234] "s__sp. JA-2-3B'a(2-13)"
## [2235] "s__toluolica"
## [2236] "s__sp. IP-1-18"
## [2237] "s__sp. M20"
## [2238] "s__sp. THAF33"
## [2239] "s__sp. CO-6"
## [2240] "s__spiralis"
## [2241] "s__sp. SORT26"
## [2242] "s__sp. S171"
## [2243] "s__massiliense"
## [2244] "s__sp. MORI2"
## [2245] "s__oncorhynchi"
## [2246] "s__weihaiensis"
## [2247] "s__sp. 200"
## [2248] "s__proteolyticus"
## [2249] "s__sp. CY-G"
## [2250] "s__breoganii"
## [2251] "s__weissii"
## [2252] "s__sp. RLB1-33"
## [2253] "s__vulgare"
## [2254] "s__sp. PET50"
## [2255] "s__formicivorans"
## [2256] "s__verrucosa"
## [2257] "s__oryzihabitans"
## [2258] "s__sp. SSW1-51"
## [2259] "s__oligotrophus"
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## [2260] "s__dongxiuzhuiae"
## [2261] "s__sp. MMS21-STM10"
## [2262] "s__sp. DG25A"
## [2263] "s__urinalis"
## [2264] "s__duncaniae"
## [2265] "s__hakodatensis"
## [2266] "s__pseudomesenteroides"
## [2267] "s__sp. I3-3-33"
## [2268] "s__vietnamensis"
## [2269] "s__piscinae"
## [2270] "s__sp. B-3"
## [2271] "s__sp. HY006"
## [2272] "s__orientalis"
## [2273] "s__viridosporus"
## [2274] "s__sp. TGY1127_2"
## [2275] "s__acanthamoebae"
## [2276] "s__psychrotolerans"
## [2277] "s__friuliensis"
## [2278] "s__sicca"
## [2279] "s__necrophorum"
## [2280] "s__sp. CP102"
## [2281] "s__cellulovorans"
## [2282] "s__kmetyi"
## [2283] "s__endosymbiont of unidentified scaly snail isolate Monju"
## [2284] "s__backii"
## [2285] "s__woodii"
## [2286] "s__septentrionale"
## [2287] "s__sp. M1242"
## [2288] "s__sp. LX-29"
## [2289] "s__sp. SSPM10-3"
## [2290] "s__sp. K90mix"
## [2291] "s__sp. PYR15"
## [2292] "s__forsetii"
## [2293] "s__kribbensis"
## [2294] "s__sp. 905_Psudmo1"
## [2295] "s__sp. YS9"
## [2296] "s__mycoides"
## [2297] "s__merdae"
## [2298] "s__bathyalis"
## [2299] "s__virosa"
## [2300] "s__sp. 4G125"
## [2301] "s__piscicida"
## [2302] "s__sp. L-2-11"
## [2303] "s__gibsoniae"
## [2304] "s__teichomyceticus"
## [2305] "s__sp. DMF-1"
## [2306] "s__plantisponsor"
## [2307] "s__sp. MSMB617WGS"
## [2308] "s__monocytogenes"
## [2309] "s__sp. CFSAN093246"
## [2310] "s__pantothenticus"
## [2311] "s__mucimassa"
## [2312] "s__hibernicus"
## [2313] "s__neteri"
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## [2314] "s__phragmitetus"
## [2315] "s__epipsammum"
## [2316] "s__derwentensis"
## [2317] "s__sp. ESL0775"
## [2318] "s__hypogea"
## [2319] "s__ellisii"
## [2320] "s__falsenii"
## [2321] "s__limosum"
## [2322] "s__sp. oral taxon 475"
## [2323] "s__metallidurans"
## [2324] "s__sp. MM213"
## [2325] "s__eucalypticola"
## [2326] "s__sp. OIL-1"
## [2327] "s__acidoterrestris"
## [2328] "s__gonidiaformans"
## [2329] "s__sp. FWKO B"
## [2330] "s__[Clostridium] innocuum"
## [2331] "s__piscinale"
## [2332] "s__sp. 432"
## [2333] "s__sp. 20-132"
## [2334] "s__sp. JZ18"
## [2335] "s__sp. CCS1"
## [2336] "s__sp. WH 8101"
## [2337] "s__sanarellii"
## [2338] "s__kanamyceticus"
## [2339] "s__sp. P11G5"
## [2340] "s__xylinus"
## [2341] "s__sp. A10-1-5-1"
## [2342] "s__inopinatus"
## [2343] "s__sp. DG56-2"
## [2344] "s__acidocaldarius"
## [2345] "s__acetylicum"
## [2346] "s__sp. AOP6"
## [2347] "s__compactum"
## [2348] "s__gazogenes"
## [2349] "s__sp. 2447"
## [2350] "s__sp. LUNF3"
## [2351] "s__sp. AMBV1719"
## [2352] "s__arenae"
## [2353] "s__luticellarii"
## [2354] "s__sp. JDR-2"
## [2355] "s__fracticalcis"
## [2356] "s__brenneri"
## [2357] "s__flavithermus"
## [2358] "s__vaccinii"
## [2359] "s__pseudomallei"
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## [2361] "s__macrogoltabida"
## [2362] "s__sp. SMC-8"
## [2363] "s__sp. 7D3"
## [2364] "s__haemolyticum"
## [2365] "s__sp. KA22"
## [2366] "s__sp. Marseille-Q7826"
## [2367] "s__carnosum"
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## [2368] "s__purpureochromogenes"
## [2369] "s__sp. RerS4"
## [2370] "s__multiformis"
## [2371] "s__shinshuensis"
## [2372] "s__nagelii"
## [2373] "s__sp. YC1"
## [2374] "s__sp. A18/5-2"
## [2375] "s__fulva"
## [2376] "s__sp. A12"
## [2377] "s__sp. K5869"
## [2378] "s__sp. 09C 129"
## [2379] "s__sp. 103DPR2"
## [2380] "s__sp. StRB126"
## [2381] "s__sp. HL-66"
## [2382] "s__sp. ZM22"
## [2383] "s__sp. XHJ-5"
## [2384] "s__sp. PCC 7336"
## [2385] "s__pretoriensis"
## [2386] "s__seleniipraecipitans"
## [2387] "s__Candidatus Endomicrobium trichonymphae"
## [2388] "s__frederiksbergensis"
## [2389] "s__mucicolens"
## [2390] "s__sp. CS20"
## [2391] "s__subglaciescola"
## [2392] "s__physcomitrellae"
## [2393] "s__capitis"
## [2394] "s__sp. IVB6233"
## [2395] "s__qitaiheensis"
## [2396] "s__sp. ES6"
## [2397] "s__sp. MC19"
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## [2399] "s__urashimensis"
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## [2401] "s__syringae"
## [2402] "s__aerogenes"
## [2403] "s__praevalens"
## [2404] "s__zymae"
## [2405] "s__subrutilus"
## [2406] "s__sp. I4-1-79"
## [2407] "s__inositola"
## [2408] "s__ficaria"
## [2409] "s__plantarum"
## [2410] "s__sp. P5"
## [2411] "s__katrae"
## [2412] "s__nicotianae"
## [2413] "s__fragilis"
## [2414] "s__autoethanogenum"
## [2415] "s__ureilytica"
## [2416] "s__salegens"
## [2417] "s__sp. LA31"
## [2418] "s__maricola"
## [2419] "s__sp. NS4"
## [2420] "s__equolifaciens"
## [2421] "s__qomolangmaensis"
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## [2423] "s__sp. HC6"
## [2424] "s__salexigens"
## [2425] "s__sp. AQ5-07"
## [2426] "s__sp. TEGF004"
## [2427] "s__huguangmaarense"
## [2428] "s__benzoatilyticus"
## [2429] "s__qilianensis"
## [2430] "s__sp. SL130"
## [2431] "s__equi"
## [2432] "s__blasticum"
## [2433] "s__auratinigra"
## [2434] "s__sp. SirexAA-E"
## [2435] "s__butyricum"
## [2436] "s__sp. AP8"
## [2437] "s__crocea"
## [2438] "s__shinjukuense"
## [2439] "s__sp. HN-2-9-2"
## [2440] "s__furentiruminis"
## [2441] "s__natalensis"
## [2442] "s__xanthophaeus"
## [2443] "s__breve"
## [2444] "s__sp. RKMC-009"
## [2445] "s__mirum"
## [2446] "s__sp. WMMD791"
## [2447] "s__pseudocatenulatum"
## [2448] "s__dechloratans"
## [2449] "s__sp. XT11"
## [2450] "s__gummiphilus"
## [2451] "s__lactis"
## [2452] "s__sp. SSBR10-3"
## [2453] "s__[Clostridium] hylemonae"
## [2454] "s__magnusonii"
## [2455] "s__yushuensis"
## [2456] "s__hirae"
## [2457] "s__pratisalsi"
## [2458] "s__acetoxidans"
## [2459] "s__sp. AR07"
## [2460] "s__medium"
## [2461] "s__sp. GF20"
## [2462] "s__sp. SCSIO 76264"
## [2463] "s__gilvum"
## [2464] "s__sp. RHB36-C18"
## [2465] "s__acetobutylicum"
## [2466] "s__epidermidicanis"
## [2467] "s__resinovorum"
## [2468] "s__ruminantium"
## [2469] "s__fontium"
## [2470] "s__sp. SW4"
## [2471] "s__slithyformis"
## [2472] "s__sp. Ai-910"
## [2473] "s__pecoris"
## [2474] "s__sp. TS-293"
## [2475] "s__phenoliruptrix"
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## [2476] "s__soudanensis"
## [2477] "s__endosymbiont of 'Nebria riversi'"
## [2478] "s__petrolearium"
## [2479] "s__sp. M4R1S46"
## [2480] "s__sp. DM-R-R2A-13"
## [2481] "s__sp. H567"
## [2482] "s__salinum"
## [2483] "s__meningitidis"
## [2484] "s__sp. IMCC20628"
## [2485] "s__sp. oral taxon 894"
## [2486] "s__genomosp. 8"
## [2487] "s__sp. wcd7"
## [2488] "s__capitiformicae"
## [2489] "s__sp. WMMB 499"
## [2490] "s__cholangitidis"
## [2491] "s__sp. ULC335"
## [2492] "s__meliloti"
## [2493] "s__sp. 5MLIR"
## [2494] "s__sp. NRL 22/194"
## [2495] "s__acidiphilus"
## [2496] "s__sp. Arc7-DN-1"
## [2497] "s__halophytocola"
## [2498] "s__oremlandii"
## [2499] "s__sp. co_0103"
## [2500] "s__intermedius"
## [2501] "s__lentocellum"
## [2502] "s__sp. RBIITD"
## [2503] "s__suwonensis"
## [2504] "s__sp. SFB-mouse"
## [2505] "s__schaedleri"
## [2506] "s__rubneri"
## [2507] "s__carbinolicus"
## [2508] "s__sp. CCOS 191"
## [2509] "s__sp. VKM Ac-2805"
## [2510] "s__arthrosphaerae"
## [2511] "s__sp. X156"
## [2512] "s__sp. MA1X17-3"
## [2513] "s__sp. AQ5-05"
## [2514] "s__agaridevorans"
## [2515] "s__xieshaowenii"
## [2516] "s__barcinonensis"
## [2517] "s__ruthenica"
## [2518] "s__sp. F1-1"
## [2519] "s__fagopyri"
## [2520] "s__mortiferum"
## [2521] "s__sp. CP1"
## [2522] "s__sp. AJ005"
## [2523] "s__xylanilyticus"
## [2524] "s__americanum"
## [2525] "s__salicampi"
## [2526] "s__goeteborgense"
## [2527] "s__sp. SMBL_HHYL_HB1"
## [2528] "s__sp. Nx66"
## [2529] "s__anserum"
```

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## [2530] "s__chenjunshii"
## [2531] "s__cuniculi"
## [2532] "s__mimicus"
## [2533] "s__spinosum"
## [2534] "s__sp. MYC017"
## [2535] "s__pollutisoli"
## [2536] "s__acidophilus"
## [2537] "s__eucrina"
## [2538] "s__maculosa"
## [2539] "s__sabinae"
## [2540] "s__cardium"
## [2541] "s__anthophila"
## [2542] "s__onobrychidis"
## [2543] "s__citreum"
## [2544] "s__wulumuqiensis"
## [2545] "s__sp. CA-278952"
## [2546] "s__chlororaphis"
## [2547] "s__scatologenes"
## [2548] "s__nematophila"
## [2549] "s__photophilum"
## [2550] "s__polyxenophila"
## [2551] "s__neptuniae"
## [2552] "s__linens"
## [2553] "s__sp. 17J80-10"
## [2554] "s__gilardii"
## [2555] "s__submarina"
## [2556] "s__toyonensis"
## [2557] "s__sp. YJ47"
## [2558] "s__sp. CACC 737"
## [2559] "s__segmentosum"
## [2560] "s__sp. FW306-2-2C-D06B"
## [2561] "s__gladioli"
## [2562] "s__sp. JB2"
## [2563] "s__acidilactici"
## [2564] "s__sp. OM-1"
## [2565] "s__sp. NOUM97013"
## [2566] "s__kochii"
## [2567] "s__amiense"
## [2568] "s__sp. MIL9"
## [2569] "s__paracasei"
## [2570] "s__sp. NBEC-018"
## [2571] "s__xylanivorans"
## [2572] "s__heckeshornense"
## [2573] "s__cecorum"
## [2574] "s__sp. BG4"
## [2575] "s__sp. Marseille-Q6967"
## [2576] "s__sp. CD3-6"
## [2577] "s__profundus"
## [2578] "s__christensenii"
## [2579] "s__anatis"
## [2580] "s__kristinae"
## [2581] "s__sp. oral taxon 171"
## [2582] "s__fermentum"
## [2583] "s__glycerini"
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## [2584] "s__sp. PC121B"
## [2585] "s__sp. SC05B48"
## [2586] "s__toruni"
## [2587] "s__doricum"
## [2588] "s__sp. FW80"
## [2589] "s__dendranthematis"
## [2590] "s__sp. B3-10"
## [2591] "s__nivalisilvae"
## [2592] "s__calidilacus"
## [2593] "s__sp. LS-1"
## [2594] "s__pratensis"
## [2595] "s__sp. QA3"
## [2596] "s__sp. NS01"
## [2597] "s__reichenbachii"
## [2598] "s__sp. MB5"
## [2599] "s__sp. QT-25"
## [2600] "s__convoluta"
## [2601] "s__suaedae"
## [2602] "s__perseverans"
## [2603] "s__sp. LK10"
## [2604] "s__sp. Clip185"
## [2605] "s__hydrothermale"
## [2606] "s__sp. F3-2"
## [2607] "s__aphidicola"
## [2608] "s__sp. LHK192"
## [2609] "s__pluranimalium"
## [2610] "s__sp. SC041"
## [2611] "s__felis"
## [2612] "s__fabrum"
## [2613] "s__sp. H8"
## [2614] "s__kalamazoonensis"
## [2615] "s__sulfonivorans"
## [2616] "s__sp. DY-1"
## [2617] "s__sp. YIM 151500-1"
## [2618] "s__sp. HN38"
## [2619] "s__sp. PM3"
## [2620] "s__parainfluenzae"
## [2621] "s__turfanensis"
## [2622] "s__sp. CB04723"
## [2623] "s__ruminis"
## [2624] "s__sp. HL-2"
## [2625] "s__sp. MS1601"
## [2626] "s__campestris"
## [2627] "s__clavuligerus"
## [2628] "s__forsythia"
## [2629] "s__ihbetae"
## [2630] "s__safensis"
## [2631] "s__baliensis"
## [2632] "s__sp. SMR4y"
## [2633] "s__alvini"
## [2634] "s__sp. N3/727"
## [2635] "s__aurimucosum"
## [2636] "s__methylovorus"
## [2637] "s__sp. SWBY1"
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## [2638] "s__mannitolilytica"
## [2639] "s__sp. GilTou73"
## [2640] "s__sulfoxidireducens"
## [2641] "s__sp. Helios"
## [2642] "s__wardiae"
## [2643] "s__sp. FSL H7-0357"
## [2644] "s__sp. S3"
## [2645] "s__eulemuris"
## [2646] "s__aquiflavi"
## [2647] "s__panacis"
## [2648] "s__timonae"
## [2649] "s__gasicomitatum"
## [2650] "s__sp. 001"
## [2651] "s__mongoliensis"
## [2652] "s__pickeringii"
## [2653] "s__aerolata"
## [2654] "s__amphicarpaeae"
## [2655] "s__alcaliphilus"
## [2656] "s__sp. AC1"
## [2657] "s__choshinensis"
## [2658] "s__boronicumulans"
## [2659] "s__mikurensis"
## [2660] "s__sp. DCY119"
## [2661] "s__shaoxiangyii"
## [2662] "s__salsuginis"
## [2663] "s__sp. RAC01"
## [2664] "s__aromaticum"
## [2665] "s__suum"
## [2666] "s__balustinum"
## [2667] "s__necessarius"
## [2668] "s__metallireducens"
## [2669] "s__lycopersici"
## [2670] "s__tendae"
## [2671] "s__sp. WDL1"
## [2672] "s__agnetis"
## [2673] "s__ovata"
## [2674] "s__camelliae"
## [2675] "s__vini"
## [2676] "s__sp. SCSIO 65647"
## [2677] "s__acidiphila"
## [2678] "s__biflexa"
## [2679] "s__ureafaciens"
## [2680] "s__parvula"
## [2681] "s__marianensis"
## [2682] "s__catus"
## [2683] "s__rubrifaciens"
## [2684] "s__sp. oral taxon 190"
## [2685] "s__nitrogeniifigens"
## [2686] "s__enterocolitica"
## [2687] "s__sp. R1"
## [2688] "s__helgolandensis"
## [2689] "s__shandongense"
## [2690] "s__trehalosi"
## [2691] "s__vervacti"
```

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## [2692] "s__aerotolerans"
## [2693] "s__rossiae"
## [2694] "s__sp. SL75"
## [2695] "s__plasticadhaerens"
## [2696] "s__iranicus"
## [2697] "s__tasmaniensis"
## [2698] "s__sp. NEB 394"
## [2699] "s__sp. MYC098"
## [2700] "s__xylanolytica"
## [2701] "s__sp. WMMC415"
## [2702] "s__morbillorum"
## [2703] "s__cellulositrophicus"
## [2704] "s__longum"
## [2705] "s__showae"
## [2706] "s__sp. CM027"
## [2707] "s__sp. T1-3-2"
## [2708] "s__riviphilus"
## [2709] "s__trevisanii"
## [2710] "s__sp. DEMB1"
## [2711] "s__balticum"
## [2712] "s__sp. SSHM10-5"
## [2713] "s__guangxiense"
## [2714] "s__subvibrioides"
## [2715] "s__sp. zth1"
## [2716] "s__lagogenitalium"
## [2717] "s__durans"
## [2718] "s__sp. GOM7"
## [2719] "s__occultum"
## [2720] "s__anguillarum"
## [2721] "s__plantarii"
## [2722] "s__sp. DSM 45060"
## [2723] "s__aryabhattai"
## [2724] "s__cyclohexanicum"
## [2725] "s__sp. SCSIO 43205"
## [2726] "s__stylophorae"
## [2727] "s__sangjuense"
## [2728] "s__apodemus"
## [2729] "s__sp. B2-1-1"
## [2730] "s__diminuta"
## [2731] "s__neocaledonicus"
## [2732] "s__thermoamylovorans"
## [2733] "s__sp. COW1"
## [2734] "s__sp. X23"
## [2735] "s__obesiensis"
## [2736] "s__sp. APR13"
## [2737] "s__sp. MM224"
## [2738] "s__lipoferum"
## [2739] "s__auxotrophicus"
## [2740] "s__proavitum"
## [2741] "s__sp. PTS2502"
## [2742] "s__sp. 'Marine'"
## [2743] "s__sp. PAMC22086"
## [2744] "s__goksoeyrii"
## [2745] "s__marcescens"
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## [2746] "s__sp. SYSU D00693"
## [2747] "s__thalassa"
## [2748] "s__odoriferum"
## [2749] "s__apihabitans"
## [2750] "s__sp. SMC-2"
## [2751] "s__sp. KCTC 72723"
## [2752] "s__sp. B30-1"
## [2753] "s__sp. A30-3"
## [2754] "s__sp. M4B.F.Ca.ET.058.02.1.1"
## [2755] "s__secundus"
## [2756] "s__Paradesulfovibrio bizertensis"
## [2757] "s__sp. NicSoilB8"
## [2758] "s__phaeoluteigriseus"
## [2759] "s__saskatchewanense"
## [2760] "s__bispora"
## [2761] "s__winogradskyi"
## [2762] "s__woesei"
## [2763] "s__fontis"
## [2764] "s__alexandrii"
## [2765] "s__crocinum"
## [2766] "s__sp. Marseille-Q7238"
## [2767] "s__ochotonae"
## [2768] "s__sp. ON39_IFM12276"
## [2769] "s__sp. 11kri321"
## [2770] "s__sp. CGR1"
## [2771] "s__sp. UKPF54"
## [2772] "s__sp. PAMC28395"
## [2773] "s__phthalatica"
## [2774] "s__poae"
## [2775] "s__pseudodiphtheriticum"
## [2776] "s__amoris"
## [2777] "s__sp. Gsoil 973"
## [2778] "s__caldilimi"
## [2779] "s__sp. GSB1"
## [2780] "s__pomeroyi"
## [2781] "s__chengniuliangii"
## [2782] "s__pilosicoli"
## [2783] "s__sp. G128"
## [2784] "s__monumenti"
## [2785] "s__sp. Marseille-Q3773"
## [2786] "s__campbellii"
## [2787] "s__ursingii"
## [2788] "s__keratini"
## [2789] "s__sp. CB09001"
## [2790] "s__exile"
## [2791] "s__sp. B6464"
## [2792] "s__violaceum"
## [2793] "s__pylori"
## [2794] "s__sp. PAMC26660"
## [2795] "s__sp. X19"
## [2796] "s__fluvialis"
## [2797] "s__pennivorans"
## [2798] "s__sp. HG01"
## [2799] "s__geofontis"
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## [2801] "s__sp. P-10"
## [2802] "s__sp. CA23"
## [2803] "s__sp. XF203"
## [2804] "s__wittichii"
## [2805] "s__pentaromativorans"
## [2806] "s__hawaiiensis"
## [2807] "s__schindleri"
## [2808] "s__sp. 46C-IIa"
## [2809] "s__incarnatus"
## [2810] "s__sp. 86"
## [2811] "s__mccartyi"
## [2812] "s__sp. W7.2"
## [2813] "s__sciuri"
## [2814] "s__simiae"
## [2815] "s__prausnitzii"
## [2816] "s__fengjieae"
## [2817] "s__edaphicus"
## [2818] "s__sp. TC"
## [2819] "s__sp. SC2"
## [2820] "s__succinatutens"
## [2821] "s__hormaechei"
## [2822] "s__tanaceti"
## [2823] "s__sp. XM-1"
## [2824] "s__sp. NP247"
## [2825] "s__bereziniae"
## [2826] "s__sp. M1B.F.Ca.ET.045.04.1.1"
## [2827] "s__maltaromaticum"
## [2828] "s__sp. X9"
## [2829] "s__reuteri"
## [2830] "s__palmilytica"
## [2831] "s__sp. WKF15"
## [2832] "s__cernigliae"
## [2833] "s__sp. A1C1"
## [2834] "s__tumefaciens"
## [2835] "s__boydii"
## [2836] "s__sp. B3.7"
## [2837] "s__detoxificans"
## [2838] "s__parviboronicapiens"
## [2839] "s__sp. HSL-3221"
## [2840] "s__sp. PG104"
## [2841] "s__feriruminatoris"
## [2842] "s__sp. HP-A2021"
## [2843] "s__busanensis"
## [2844] "s__caenitepidi"
## [2845] "s__sediminilitoris"
## [2846] "s__wadsworthensis"
## [2847] "s__vaviloviae"
## [2848] "s__alcalifaciens"
## [2849] "s__sp. NLF-7-7"
## [2850] "s__defragrans"
## [2851] "s__malonaticus"
## [2852] "s__propionica"
## [2853] "s__mucosalis"
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## [2854] "s__sp. ESL0798"
## [2855] "s__sp. CYM-20-01"
## [2856] "s__velezensis"
## [2857] "s__farmeri"
## [2858] "s__currus"
## [2859] "s__sp. INDO-MA30-4"
## [2860] "s__sp. ST13-2-2"
## [2861] "s__sp. 1018B"
## [2862] "s__sp. ESL0764"
## [2863] "s__sp. Caat 7-52"
## [2864] "s__stellifer"
## [2865] "s__mucosus"
## [2866] "s__mali"
## [2867] "s__sp. 169"
## [2868] "s__sp. LPB0319"
## [2869] "s__ammonificans"
## [2870] "s__equigenitalis"
## [2871] "s__sp. 'Moss Beach'"
## [2872] "s__sp. TLY01"
## [2873] "s__sp. L3-i22"
## [2874] "s__sp. WG5"
## [2875] "s__weihenstephanensis"
## [2876] "s__sp. NS3"
## [2877] "s__sp. HA"
## [2878] "s__sp. CCB_US3_UF1"
## [2879] "s__urolithinfaciens"
## [2880] "s__aetherius"
## [2881] "s__colletis"
## [2882] "s__sp. PCC 7117"
## [2883] "s__oligotrophica"
## [2884] "s__diphtheriae"
## [2885] "s__formicae"
## [2886] "s__oryzisoli"
## [2887] "s__sp. CU5"
## [2888] "s__sp. USM3"
## [2889] "s__morelensis"
## [2890] "s__comscasis"
## [2891] "s__sp. WMMA2032"
## [2892] "s__aurantia"
## [2893] "s__sp. DAIF2"
## [2894] "s__thermocatenulatus"
## [2895] "s__tsutsugamushi"
## [2896] "s__sp. INWT7"
## [2897] "s__aurantiaca"
## [2898] "s__sp. CCBAU 53351"
## [2899] "s__sp. ADI95-16"
## [2900] "s__sp. TBR-22"
## [2901] "s__elegans"
## [2902] "s__sp. 114"
## [2903] "s__humidisoli"
## [2904] "s__sp. M62/1"
## [2905] "s__carbonacea"
## [2906] "s__socranskii"
## [2907] "s__sp. 1(2017)"
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## [2908] "s__sp. A1-2"
## [2909] "s__spadix"
## [2910] "s__sp. QA11"
## [2911] "s__baumannii"
## [2912] "s__sp. WMMD1076"
## [2913] "s__sp. BMJM1"
## [2914] "s__[Ruminococcus] gnavus"
## [2915] "s__tianjinensis"
## [2916] "s__freudenreichii"
## [2917] "s__vitulinus"
## [2918] "s__sp. CB82"
## [2919] "s__sp. GBBC 1281"
## [2920] "s__sp. JY-23"
## [2921] "s__hiberniae"
## [2922] "s__sp. MC1572"
## [2923] "s__sullae"
## [2924] "s__lactatifermentans"
## [2925] "s__sp. PAMC 28766"
## [2926] "s__zhangwenhongii"
## [2927] "s__sp. N3-W"
## [2928] "s__sp. ND 6198"
## [2929] "s__meiyuanensis"
## [2930] "s__sp. SL55"
## [2931] "s__sp. S13-6-22"
## [2932] "s__helcogenes"
## [2933] "s__sp. DSM 110487"
## [2934] "s__sp. SGAir0253"
## [2935] "s__sp. ALD11"
## [2936] "s__amnicola"
## [2937] "s__fluorescens"
## [2938] "s__poriferae"
## [2939] "s__algifaecis"
## [2940] "s__lienomycini"
## [2941] "s__fuscus"
## [2942] "s__pallidum"
## [2943] "s__umeaense"
## [2944] "s__termitidis"
## [2945] "s__rubrisubalbicans"
## [2946] "s__tabanidicola"
## [2947] "s__sp. SGAir0095"
## [2948] "s__herbifermentans"
## [2949] "s__fontanus"
## [2950] "s__sanxanigenens"
## [2951] "s__sp. SUN039"
## [2952] "s__anomalus"
## [2953] "s__hejianensis"
## [2954] "s__sp. OMZ 857"
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## [2956] "s__dorei"
## [2957] "s__heilongjiangensis"
## [2958] "s__monsensis"
## [2959] "s__badius"
## [2960] "s__neptunia"
## [2961] "s__sp. KUDC1714"
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## [2963] "s__sp. TSH100"
## [2964] "s__neptunium"
## [2965] "s__mishustinae"
## [2966] "s__sp. P02-A3a"
## [2967] "s__sulfodismutans"
## [2968] "s__sp. A16"
## [2969] "s__chungangensis"
## [2970] "s__anginosus"
## [2971] "s__acidifaciens"
## [2972] "s__sp. ZJ932"
## [2973] "s__equuli"
## [2974] "s__hydrogenoformans"
## [2975] "s__cyanogenus"
## [2976] "s__salitolerans"
## [2977] "s__sulfurreducens"
## [2978] "s__pseudoporcinus"
## [2979] "s__sp. L-07"
## [2980] "s__aestuarium"
## [2981] "s__hongdechloris"
## [2982] "s__aciditrophicus"
## [2983] "s__cohnii"
## [2984] "s__necropolis"
## [2985] "s__xenopi"
## [2986] "s__monobiae"
## [2987] "s__sp. EFPC1"
## [2988] "s__alimapuensis"
## [2989] "s__sp. T808"
## [2990] "s__dynata"
## [2991] "s__sojae"
## [2992] "s__sp. SCSIO 43195"
## [2993] "s__modestum"
## [2994] "s__capeferrum"
## [2995] "s__paeninsulae"
## [2996] "s__sp. TCU-HL1"
## [2997] "s__volantium"
## [2998] "s__vaginae"
## [2999] "s__cellulolyticus"
## [3000] "s__asymbiotica"
## [3001] "s__sp. E9-3"
## [3002] "s__sp. CX-624"
## [3003] "s__gasigenes"
## [3004] "s__histolytica"
## [3005] "s__asgharzadehiana"
## [3006] "s__sp. TRM90804"
## [3007] "s__sp. P6-10-X1"
## [3008] "s__sphenisci"
## [3009] "s__fumaroxidans"
## [3010] "s__sp. CA-258035"
## [3011] "s__yanoikuyae"
## [3012] "s__houyundeii"
## [3013] "s__gallaeciensis"
## [3014] "s__kullabergensis"
## [3015] "s__murdochii"
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## [3016] "s__sp. CL5.1"
## [3017] "s__nasdae"
## [3018] "s__enclensis"
## [3019] "s__[Pseudomonas] carboxydohydrogena"
## [3020] "s__sp. RSCCF101"
## [3021] "s__sp. Dwa41.01b"
## [3022] "s__proteolyticum"
## [3023] "s__sp. JS623"
## [3024] "s__sp. M523"
## [3025] "s__raichei"
## [3026] "s__sp. WA1-19"
## [3027] "s__roggenkampii"
## [3028] "s__esteraromaticum"
## [3029] "s__ferrugineus"
## [3030] "s__sp. PBTS 1"
## [3031] "s__sp. SYP-B4298"
## [3032] "s__gergoviae"
## [3033] "s__sp. QH-2"
## [3034] "s__sp. 140616W15"
## [3035] "s__populi"
## [3036] "s__sp. HDW3"
## [3037] "s__sp. Kera G14"
## [3038] "s__procaprae"
## [3039] "s__sp. CFWR-12"
## [3040] "s__nepalensis"
## [3041] "s__loti"
## [3042] "s__sp. WY2"
## [3043] "s__sulfidiphilus"
## [3044] "s__saidenbachensis"
## [3045] "s__hundungensis"
## [3046] "s__sp. SOG26"
## [3047] "s__sp. S30A1"
## [3048] "s__sp. HDW8"
## [3049] "s__olivoreticuli"
## [3050] "s__sp. WMMD712"
## [3051] "s__chilikensis"
## [3052] "s__sp. HSL1-3"
## [3053] "s__photometricum"
## [3054] "s__cauae"
## [3055] "s__tusciae"
## [3056] "s__wadei"
## [3057] "s__bongori"
## [3058] "s__aponinum"
## [3059] "s__paracollinoides"
## [3060] "s__cylindroides"
## [3061] "s__cremeum"
## [3062] "s__varium"
## [3063] "s__psychrosaccharolyticus"
## [3064] "s__flavigena"
## [3065] "s__sp. IT6"
## [3066] "s__salyersiae"
## [3067] "s__pittii"
## [3068] "s__viridescens"
## [3069] "s__caviae"
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## [3070] "s__sp. 186"
## [3071] "s__sp. oral taxon 498"
## [3072] "s__sp. NHF165"
## [3073] "s__sp. SCSIO 12839"
## [3074] "s__tyrobutyricum"
## [3075] "s__butyrica"
## [3076] "s__kisseleviana"
## [3077] "s__diazotrophica"
## [3078] "s__sulfidivorans"
## [3079] "s__sp. JB150"
## [3080] "s__sp. HUAS 14-6"
## [3081] "s__paralicheniformis"
## [3082] "s__sp. NMCR1094"
## [3083] "s__sp. B4-1-4"
## [3084] "s__sp. 15R"
## [3085] "s__sp. WMMA1976"
## [3086] "s__wangjianweii"
## [3087] "s__Candidatus Promineofilum breve"
## [3088] "s__virginiensis"
## [3089] "s__thiaminolyticus"
## [3090] "s__sp. HDW4B"
## [3091] "s__vestitus"
## [3092] "s__cycloheptanicus"
## [3093] "s__acidaminophilum"
## [3094] "s__oceanibius"
## [3095] "s__coprosuis"
## [3096] "s__sp. GMY02"
## [3097] "s__nigrificans"
## [3098] "s__sp. YA7-1"
## [3099] "s__thalassium"
## [3100] "s__sp. FSL R5-0345"
## [3101] "s__cookii"
## [3102] "s__haloalkaliphila"
## [3103] "s__pinisoli"
## [3104] "s__sp. ESL0680"
## [3105] "s__viscosus"
## [3106] "s__sp. CBW1004"
## [3107] "s__sp. CDRTa11"
## [3108] "s__sp. Pen4"
## [3109] "s__foraminis"
## [3110] "s__gelatinilytica"
## [3111] "s__globosa"
## [3112] "s__crustorum"
## [3113] "s__phycosphaerae"
## [3114] "s__sp. HY158"
## [3115] "s__cochlearium"
## [3116] "s__sp. SCHIC003"
## [3117] "s__provencense"
## [3118] "s__fluminis"
## [3119] "s__sp. GJ3"
## [3120] "s__icense"
## [3121] "s__marmotae"
## [3122] "s__xerosis"
## [3123] "s__buchneri"
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## [3124] "s__albicereus"
## [3125] "s__sp. B11"
## [3126] "s__nanhainus"
## [3127] "s__lacuslunae"
## [3128] "s__thiosulfatoxidans"
## [3129] "s__sp. SMC90"
## [3130] "s__dysenteriae"
## [3131] "s__primitia"
## [3132] "s__retbaense"
## [3133] "s__sp. YIK13"
## [3134] "s__sp. THAF5a"
## [3135] "s__dumasiana"
## [3136] "s__sp. M8A.F.Ca.ET.057.01.1.1"
## [3137] "s__guillouiae"
## [3138] "s__sp. H17E-10"
## [3139] "s__sp. NIES-3755"
## [3140] "s__sp. 195"
## [3141] "s__sp. Mc7"
## [3142] "s__organophilum"
## [3143] "s__sp. Kuro-4"
## [3144] "s__perfilievii"
## [3145] "s__estertheticum"
## [3146] "s__sp. MUD11"
## [3147] "s__cuniculorum"
## [3148] "s__longicatena"
## [3149] "s__autotrophicus"
## [3150] "s__sp. MT58"
## [3151] "s__azotonutricia"
## [3152] "s__cattleyae"
## [3153] "s__sp. EJY3"
## [3154] "s__innesii"
## [3155] "s__sp. YLGW01"
## [3156] "s__aeolicus"
## [3157] "s__porphyridii"
## [3158] "s__sp. WY4"
## [3159] "s__chipingensis"
## [3160] "s__beringensis"
## [3161] "s__sp. LM 6"
## [3162] "s__uniformis"
## [3163] "s__obeum"
## [3164] "s__animaloris"
## [3165] "s__davaonensis"
## [3166] "s__sp. B2-8-5"
## [3167] "s__sp. CS2"
## [3168] "s__agglomerans"
## [3169] "s__sp. ORNL1"
## [3170] "s__macerans"
## [3171] "s__sp. KACC 23027"
## [3172] "s__hydrogeniformans"
## [3173] "s__phocae"
## [3174] "s__sp. PRF04-17"
## [3175] "s__sp. PAMC20947"
## [3176] "s__poyangense"
## [3177] "s__Verrucosispora sp. NA02020"
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## [3178] "s__sp. GQFP"
## [3179] "s__odontotermitis"
## [3180] "s__cucumeris"
## [3181] "s__sp. CA-230715"
## [3182] "s__sp. ZJ70"
## [3183] "s__sp. TKS"
## [3184] "s__Candidatus Sulfurimonas baltica"
## [3185] "s__sp. YMD61"
## [3186] "s__coxensis"
## [3187] "s__sp. ESL0728"
## [3188] "s__odorifer"
## [3189] "s__sp. MT41"
## [3190] "s__vagans"
## [3191] "s__comes"
## [3192] "s__campinensis"
## [3193] "s__pseudococcoides"
## [3194] "s__sp. SZ-19"
## [3195] "s__sp. ZJ785"
## [3196] "s__quintana"
## [3197] "s__sulfuriphilus"
## [3198] "s__aerophila"
## [3199] "s__montiporae"
## [3200] "s__zucineum"
## [3201] "s__suantsaii"
## [3202] "s__parahaemolyticus"
## [3203] "s__rosettiformans"
## [3204] "s__sp. DL440"
## [3205] "s__sp. CJ11"
## [3206] "s__maltophilia"
## [3207] "s__iterans"
## [3208] "s__granulosum"
## [3209] "s__sp. N3-2A"
## [3210] "s__sp. cx-55"
## [3211] "s__sp. MC1750"
## [3212] "s__sp. T1293"
## [3213] "s__endophyticum"
## [3214] "s__sp. MCCC 1A13316"
## [3215] "s__sp. USMAA2-4"
## [3216] "s__salanitronis"
## [3217] "s__sp. SB3-54"
## [3218] "s__boenickei"
## [3219] "s__linckia"
## [3220] "s__ramosa"
## [3221] "s__chelonae"
## [3222] "s__siphonis"
## [3223] "s__goldsteinii"
## [3224] "s__sp. 9"
## [3225] "s__humanifaecis"
## [3226] "s__sp. NA06056"
## [3227] "s__sp. 21P"
## [3228] "s__sp. SS"
## [3229] "s__anulatus"
## [3230] "s__fandaimingii"
## [3231] "s__insubricum"
```

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## [3232] "s__thermosphaericus"
## [3233] "s__citreus"
## [3234] "s__luporum"
## [3235] "s__sp. 2003-09-23"
## [3236] "s__sp. MSP4-1"
## [3237] "s__sp. PAMC 26642"
## [3238] "s__fibrisolvens"
## [3239] "s__sp. ZY-1-1"
## [3240] "s__shimadae"
## [3241] "s__culicicola"
## [3242] "s__sanfranciscensis"
## [3243] "s__sp. FSL R7-0273"
## [3244] "s__sp. CA1"
## [3245] "s__widdelii"
## [3246] "s__majanohamensis"
## [3247] "s__sp. CAA11"
## [3248] "s__multiresinivorans"
## [3249] "s__sp. JL08"
## [3250] "s__sp. SGAir0471"
## [3251] "s__aegosomaticola"
## [3252] "s__durmitorensis"
## [3253] "s__avellanae"
## [3254] "s__sp. PM5"
## [3255] "s__sp. IVB6181"
## [3256] "s__basilensis"
## [3257] "s__sp. BIOS-E4-1"
## [3258] "s__trematum"
## [3259] "s__methanica"
## [3260] "s__sp. ES-001"
## [3261] "s__hindlerae"
## [3262] "s__sp. PLM2"
## [3263] "s__saigonensis"
## [3264] "s__distasonis"
## [3265] "s__sp. 007"
## [3266] "s__lundensis"
## [3267] "s__ivorii"
## [3268] "s__sp. PAMC28666"
## [3269] "s__gregarius"
## [3270] "s__sp. X514"
## [3271] "s__granuli"
## [3272] "s__sp. BRD128"
## [3273] "s__lenghuensis"
## [3274] "s__oecophyllae"
## [3275] "s__sp. DNDY-54"
## [3276] "s__Rickettsiales endosymbiont of Stachyamoeba lipophora"
## [3277] "s__pauculus"
## [3278] "s__sp. L3A3"
## [3279] "s__crinochetorum"
## [3280] "s__sp. ZJ-18"
## [3281] "s__pusense"
## [3282] "s__sp. MAS-1"
## [3283] "s__sp. CAU 1644"
## [3284] "s__gallinacea"
## [3285] "s__sp. TF1N1"
```

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## [3286] "s__imperatoris"
## [3287] "s__piscifermentans"
## [3288] "s__sp. AK164"
## [3289] "s__sp. F-323"
## [3290] "s__sp. Te-1"
## [3291] "s__halobius"
## [3292] "s__primoryensis"
## [3293] "s__congonensis"
## [3294] "s__raffinosus"
## [3295] "s__methanolivorans"
## [3296] "s__sp. Y33R10-2"
## [3297] "s__chromatireducens"
## [3298] "s__[Enterobacter] lignolyticus"
## [3299] "s__hungatei"
## [3300] "s__genitalium"
## [3301] "s__edwinii"
## [3302] "s__sp. oral taxon 368"
## [3303] "s__hwajinpoensis"
## [3304] "s__sp. I09"
## [3305] "s__sp. OMA3-2"
## [3306] "s__sp. IP-3-29"
## [3307] "s__radiovictrix"
## [3308] "s__sp. ACO-34A"
## [3309] "s__glomerans"
## [3310] "s__thailandica"
## [3311] "s__sp. MA9"
## [3312] "s__sp. WQ 127309"
## [3313] "s__asaccharolytica"
## [3314] "s__oshimai"
## [3315] "s__sp. TWE2"
## [3316] "s__singularis"
## [3317] "s__venetianus"
## [3318] "s__sp. 16-5"
## [3319] "s__thermosaccharolyticum"
## [3320] "s__paralimentarius"
## [3321] "s__donghaensis"
## [3322] "s__hydrolyticum"
## [3323] "s__sp. BR1-192"
## [3324] "s__sp. MSH1"
## [3325] "s__arlettae"
## [3326] "s__molinativorax"
## [3327] "s__naeslundii"
## [3328] "s__sp. YPW6"
## [3329] "s__seriolae"
## [3330] "s__clostridioformis"
## [3331] "s__sp. QWL-01"
## [3332] "s__wutianyii"
## [3333] "s__volcania"
## [3334] "s__sp. SH-1"
## [3335] "s__sp. HN8-3"
## [3336] "s__sp. Cs-700"
## [3337] "s__stenotrophicus"
## [3338] "s__vinosum"
## [3339] "s__turicensis"
```

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## [3340] "s__ciceri"
## [3341] "s__matruchotii"
## [3342] "s__curtisii"
## [3343] "s__sp. SAORIC-580"
## [3344] "s__dhakensis"
## [3345] "s__saccharolyticus"
## [3346] "s__paraplantarum"
## [3347] "s__epidermidis"
## [3348] "s__aptenodytis"
## [3349] "s__sp. PAMC25564"
## [3350] "s__sp. MF30-B"
## [3351] "s__meridiana"
## [3352] "s__chejuensis"
## [3353] "s__polyisoprenivorans"
## [3354] "s__crudilactis"
## [3355] "s__atrocyanea"
## [3356] "s__caldarium"
## [3357] "s__piger"
## [3358] "s__pondensis"
## [3359] "s__sp. T173"
## [3360] "s__asburiae"
## [3361] "s__sp. WKF20"
## [3362] "s__sp. HC52"
## [3363] "s__sp. SCSIO 43702"
## [3364] "s__manganicus"
## [3365] "s__kalidii"
## [3366] "s__sp. VN1"
## [3367] "s__sp. KD337-16"
## [3368] "s__hepaticus"
## [3369] "s__formicexedens"
## [3370] "s__symbiotica"
## [3371] "s__sp. VF16"
## [3372] "s__depolymerans"
## [3373] "s__myrionectae"
## [3374] "s__smithii"
## [3375] "s__knackmussii"
## [3376] "s__sp. PAMC22021"
## [3377] "s__glauca"
## [3378] "s__zhongnanshanii"
## [3379] "s__sp. HNA39"
## [3380] "s__werkmanii"
## [3381] "s__cellulosum"
## [3382] "s__sp. IHB B 17019"
## [3383] "s__halophilum"
## [3384] "s__sp. EAS-AB2608"
## [3385] "s__sp. NH-16"
## [3386] "s__sp. ZJ1417"
## [3387] "s__mucidolens"
## [3388] "s__sphagniphila"
## [3389] "s__dieselolei"
## [3390] "s__creatinolyticus"
## [3391] "s__parvus"
## [3392] "s__petrolei"
## [3393] "s__sp. Tu 2975"
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## [3394] "s__sp. 6(2017)"
## [3395] "s__lutaonensis"
## [3396] "s__archaeovorus"
## [3397] "s__sp. IVB6238"
## [3398] "s__sp. BSs20148"
## [3399] "s__neoaurum"
## [3400] "s__sp. T8"
## [3401] "s__alocis"
## [3402] "s__narathiwatensis"
## [3403] "s__saanensis"
## [3404] "s__sp. HY1793"
## [3405] "s__marisflavi"
## [3406] "s__putidum"
## [3407] "s__sp. S4-F44"
## [3408] "s__methylohalidivorans"
## [3409] "s__globosus"
## [3410] "s__sp. c-25"
## [3411] "s__sp. ESL0684"
## [3412] "s__sp. PCC 7418"
## [3413] "s__sp. W003"
## [3414] "s__saccharolytica"
## [3415] "s__tataouinensis"
## [3416] "s__glaciei"
## [3417] "s__sp. AP-Ainpum-60-G11"
## [3418] "s__bogorovii"
## [3419] "s__sp. TH2"
## [3420] "s__koreense"
## [3421] "s__sp. XS-30"
## [3422] "s__subtile"
## [3423] "s__psychroresistens"
## [3424] "s__sp. PAMC21692"
## [3425] "s__sp. SCA2728.1_7"
## [3426] "s__akesuensis"
## [3427] "s__magneticum"
## [3428] "s__lacrimiformis"
## [3429] "s__beimenensis"
## [3430] "s__bugandensis"
## [3431] "s__canettii"
## [3432] "s__porcorum"
## [3433] "s__dankookensis"
## [3434] "s__cepacia"
## [3435] "s__echinofusca"
## [3436] "s__sp. Hca4"
## [3437] "s__pseudamarae"
## [3438] "s__soli (ex Cha et al. 2016)"
## [3439] "s__sp. VG12"
## [3440] "s__sp. JNUCC-31"
## [3441] "s__sp. Alg239-R112"
## [3442] "s__acidipropionici"
## [3443] "s__uterequi"
## [3444] "s__sonnei"
## [3445] "s__nivis"
## [3446] "s__tumorigenes"
## [3447] "s__corydidari"
```

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## [3448] "s__ananatis"
## [3449] "s__dentalis"
## [3450] "s__pseudomycoides"
## [3451] "s__sagamiharensis"
## [3452] "s__sp. Rer75"
## [3453] "s__sp. PSE14"
## [3454] "s__sp. MM227"
## [3455] "s__farciminis"
## [3456] "s__nuda"
## [3457] "s__molare"
## [3458] "s__sp. BRD67"
## [3459] "s__luteum"
## [3460] "s__sakazakii"
## [3461] "s__saccharoperbutylacetonicum"
## [3462] "s__sp. DR822"
## [3463] "s__sp. GC21"
## [3464] "s__macedonicus"
## [3465] "s__prasinus"
## [3466] "s__denticolens"
## [3467] "s__sp. 3-20A1M"
## [3468] "s__efficiens"
## [3469] "s__sp. S2-65"
## [3470] "s__orale"
## [3471] "s__ishizawai"
## [3472] "s__sp. PHM005"
## [3473] "s__spanius"
## [3474] "s__sp. BTAi1"
## [3475] "s__cancerogenus"
## [3476] "s__dubius"
## [3477] "s__sp. LMS39"
## [3478] "s__excentricus"
## [3479] "s__rogosae"
## [3480] "s__humosa"
## [3481] "s__sp. S22"
## [3482] "s__magnum"
## [3483] "s__enzymogenes"
## [3484] "s__histicola"
## [3485] "s__sp. Ery5"
## [3486] "s__sp. L5B5"
## [3487] "s__bicirculans"
## [3488] "s__amycolatum"
## [3489] "s__sp. GD1P12"
## [3490] "s__halodenitrificans"
## [3491] "s__joostei"
## [3492] "s__sp. M0911"
## [3493] "s__vitaeruminis"
## [3494] "s__[Clostridium] scindens"
## [3495] "s__howellii"
## [3496] "s__sp. LB1"
## [3497] "s__sp. oral taxon 416"
## [3498] "s__sp. E222"
## [3499] "s__sp. 693-2"
## [3500] "s__euniceicola"
## [3501] "s__taiwanense"
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## [3502] "s__sp. YPG26"
## [3503] "s__capsulatum"
## [3504] "s__morindae"
## [3505] "s__sp. DHOD12"
## [3506] "s__ureilyticus"
## [3507] "s__xiamenensis"
## [3508] "s__argentinensis"
## [3509] "s__zamorensis"
## [3510] "s__serinivorans"
## [3511] "s__equipercicus"
## [3512] "s__sp. THAF38"
## [3513] "s__sp. SOD02"
## [3514] "s__sp. R5-41"
## [3515] "s__sp. BP5-C20A"
## [3516] "s__naozhouensis"
## [3517] "s__ochraceum"
## [3518] "s__sp. B510"
## [3519] "s__santarosai"
## [3520] "s__sp. GRR-S6-38"
## [3521] "s__sp. BALOs_7"
## [3522] "s__sp. BL0902"
## [3523] "s__sp. NMS14P"
## [3524] "s__fructivorans"
## [3525] "s__sp. CV7422"
## [3526] "s__obsidiansis"
## [3527] "s__trichosporium"
## [3528] "s__pasteuri"
## [3529] "s__trachydisci"
## [3530] "s__sp. ASG 101"
## [3531] "s__hollisae"
## [3532] "s__sp. HSf4"
## [3533] "s__hanseatica"
## [3534] "s__thermosphacta"
## [3535] "s__lincolnensis"
## [3536] "s__sp. KPN54798"
## [3537] "s__cucurbitae"
## [3538] "s__sp. MFA1 R4"
## [3539] "s__sp. At-9b"
## [3540] "s__sarraceniae"
## [3541] "s__mageritense"
## [3542] "s__pullorum"
## [3543] "s__sp. BT-65"
## [3544] "s__ferrivorans"
## [3545] "s__succinatiphilus"
## [3546] "s__sp. NCPPB 3576"
## [3547] "s__minuta"
## [3548] "s__sp. GO-4"
## [3549] "s__durus"
## [3550] "s__fungorum"
## [3551] "s__sp. 5GHs7-4"
## [3552] "s__sp. GSA-30"
## [3553] "s__saponilacus"
## [3554] "s__sp. 8C15b"
## [3555] "s__ramosus"
```

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## [3556] "s__herdmanii"
## [3557] "s__universalis"
## [3558] "s__basiliense"
## [3559] "s__frumenti"
## [3560] "s__sp. A2-16"
## [3561] "s__sp. str. 'China'"
## [3562] "s__elsdenii"
## [3563] "s__sp. P3"
## [3564] "s__alkaniclasticus"
## [3565] "s__oestradiolicum"
## [3566] "s__sp. W0125-5"
## [3567] "s__hamburgensis"
## [3568] "s__caerulea"
## [3569] "s__sp. MIZ03"
## [3570] "s__sp. SALV-R1"
## [3571] "s__sp. KNU-23"
## [3572] "s__sp. LIG4"
## [3573] "s__litopenaei"
## [3574] "s__sp. MEBOG07"
## [3575] "s__pactum"
## [3576] "s__mesophila"
## [3577] "s__yonginensis"
## [3578] "s__sp. JS614"
## [3579] "s__pallidus"
## [3580] "s__clariflavus"
## [3581] "s__wadsworthii"
## [3582] "s__wuianus"
## [3583] "s__cardiffensis"
## [3584] "s__gracile"
## [3585] "s__wallacei"
## [3586] "s__sp. oral taxon 299"
## [3587] "s__sp. HUAS 13-4"
## [3588] "s__sp. DN3"
## [3589] "s__kyphosi"
## [3590] "s__hankookensis"
## [3591] "s__krabiensis"
## [3592] "s__labii"
## [3593] "s__sp. A29-2"
## [3594] "s__sp. NH8B"
## [3595] "s__sp. FU40"
## [3596] "s__sp. NBH84"
## [3597] "s__spectabilis"
## [3598] "s__sp. FDAARGOS_727"
## [3599] "s__sp. DSM 110486"
## [3600] "s__sp. D12"
## [3601] "s__sp. FDAARGOS 1242"
## [3602] "s__viridiflava"
## [3603] "s__sp. NHP19-012"
## [3604] "s__pseudohinzii"
## [3605] "s__slackii"
## [3606] "s__sp. YJN-G"
## [3607] "s__dongkuii"
## [3608] "s__cerebrosus"
## [3609] "s__lienii"
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## [3610] "s__terpenotabidum"
## [3611] "s__sp. phDV1"
## [3612] "s__sp. Go40/10"
## [3613] "s__incognita"
## [3614] "s__sp. URMO17WK12:I11"
## [3615] "s__conchae"
## [3616] "s__sp. MST-110588"
## [3617] "s__rhinotracheale"
## [3618] "s__ginsengisoli An et al. 2013"
## [3619] "s__acidiformans"
## [3620] "s__terminaliae"
## [3621] "s__hengshuiensis"
## [3622] "s__tropicalis"
## [3623] "s__sp. 0141_2"
## [3624] "s__sp. YY7918"
## [3625] "s__vibrioides"
## [3626] "s__smaragdinae"
## [3627] "s__adolescentis"
## [3628] "s__translucens"
## [3629] "s__sp. Psy1"
## [3630] "s__griseoviridis"
## [3631] "s__rubripertincta"
## [3632] "s__sp. MA3_2.13"
## [3633] "s__echinaurantiaca"
## [3634] "s__sp. C49"
## [3635] "s__sp. NR2"
## [3636] "s__laterosporus"
## [3637] "s__sinipercae"
## [3638] "s__bisphenolicum"
## [3639] "s__sp. Je 1-369"
## [3640] "s__victoriana"
## [3641] "s__sp. TNS106"
## [3642] "s__sp. PAMC25264"
## [3643] "s__phosphorivorans"
## [3644] "s__pamelaeae"
## [3645] "s__sp. IHB B 3084"
## [3646] "s__sp. 21OH12SH02B-Prov"
## [3647] "s__restricta"
## [3648] "s__sp. BSL-9"
## [3649] "s__sp. G4"
## [3650] "s__nanhaiensis"
## [3651] "s__sp. HL-111"
## [3652] "s__sp. B006"
## [3653] "s__pratense"
## [3654] "s__schubertii"
## [3655] "s__sp. DY2415"
## [3656] "s__sp. SH-PL62"
## [3657] "s__rhododendri"
## [3658] "s__sp. 5420S-77"
## [3659] "s__sp. IVB6214"
## [3660] "s__genosp. L"
## [3661] "s__apinorum"
## [3662] "s__heparinolyticus"
## [3663] "s__ruginosibacter"
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```
## [3664] "s__sp. E602"
## [3665] "s__seoulensis"
## [3666] "s__onnuriiensis"
## [3667] "s__hellenica"
## [3668] "s__sp. PTS2304"
## [3669] "s__abietis"
## [3670] "s__chinense"
## [3671] "s__salsibiostraticola"
## [3672] "s__sp. SK37"
## [3673] "s__sp. CL21"
## [3674] "s__sp. Chiba101"
## [3675] "s__citrulli"
## [3676] "s__sp. TY2-98"
## [3677] "s__olearius"
## [3678] "s__pantotrophus"
## [3679] "s__sp. R4-39-08"
## [3680] "s__gipuzkoensis"
## [3681] "s__sp. NIBR11"
## [3682] "s__sp. BT-229"
## [3683] "s__sp. C8S0"
## [3684] "s__kunjamensis"
## [3685] "s__endolithicus"
## [3686] "s__argi"
## [3687] "s__respiraculi"
## [3688] "s__bornimense"
## [3689] "s__sp. KACC 23026"
## [3690] "s__desertarenae"
## [3691] "s__sp. RUD330"
## [3692] "s__sp. SCSIO 64092"
## [3693] "s__sp. MC1"
## [3694] "s__merionis"
## [3695] "s__sp. zg-1006"
## [3696] "s__kimchii"
## [3697] "s__plumbiphila"
## [3698] "s__unzii"
## [3699] "s__phocirhinis"
## [3700] "s__aphrophilus"
## [3701] "s__frederiksbergense"
## [3702] "s__sp. SCUT-3"
## [3703] "s__associata"
## [3704] "s__cyclinae"
## [3705] "s__angulatum"
## [3706] "s__mesophilicum"
## [3707] "s__arachidis"
## [3708] "s__meridiei"
## [3709] "s__ureicelerivorans"
## [3710] "s__acetiphilus"
## [3711] "s__zhangbolii"
## [3712] "s__cavolei"
## [3713] "s__sp. JKS000199"
## [3714] "s__haemophilum"
## [3715] "s__sp. E03"
## [3716] "s__mesonae"
## [3717] "s__sp. SI"
```

```
## [3718] "s__sp. NicSoilB4"
## [3719] "s__zhoupengii"
## [3720] "s__sp. 'deep sea'"
## [3721] "s__iheyensis"
## [3722] "s__decolorationis"
## [3723] "s__zoogloeoides"
## [3724] "s__finegoldii"
## [3725] "s__sp. 135"
## [3726] "s__mobaraensis"
## [3727] "s__violaceus"
## [3728] "s__glutamicum"
## [3729] "s__auensis"
## [3730] "s__saccincola"
## [3731] "s__glycolicus"
## [3732] "s__citronellolis"
## [3733] "s__sp. BB3-R1"
## [3734] "s__aquimarina"
## [3735] "s__sp. FW305-BF8"
## [3736] "s__insecticola"
## [3737] "s__virtanenii"
## [3738] "s__sp. YGD11-2"
## [3739] "s__fanqingshengii"
## [3740] "s__sp. SYK-6"
## [3741] "s__sp. 72-3"
## [3742] "s__rapamycinicus"
## [3743] "s__atratus"
## [3744] "s__sp. PAMC 29467"
## [3745] "s__sp. LS2"
## [3746] "s__viridarii"
## [3747] "s__calvus"
## [3748] "s__wexlerae"
## [3749] "s__sp. Marseille-Q4943"
## [3750] "s__seriniphilus"
## [3751] "s__sp. Idaho Grape"
## [3752] "s__sp. NB 10"
## [3753] "s__confluentis"
## [3754] "s__sp. PAMC 25486"
## [3755] "s__ventriosum"
## [3756] "s__lanienae"
## [3757] "s__goodii"
## [3758] "s__plautii"
## [3759] "s__sp. M10"
## [3760] "s__sp. ES2-1"
## [3761] "s__welbionis"
## [3762] "s__miroungirhinis"
## [3763] "s__jinshanensis"
## [3764] "s__ubonensis"
## [3765] "s__casuarinae"
## [3766] "s__pettenkoferi"
## [3767] "s__sp. RAC08"
## [3768] "s__marcusii"
## [3769] "s__opacus"
## [3770] "s__salmoniphilum"
## [3771] "s__saltans"
```

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## [3772] "s__sp. CE17"
## [3773] "s__sp. R14(2021)"
## [3774] "s__neuii"
## [3775] "s__cavourensis"
## [3776] "s__avidum"
## [3777] "s__albigilva"
## [3778] "s__sp. WMMD714"
## [3779] "s__alpina"
## [3780] "s__sp. PAMC28757"
## [3781] "s__mixta"
## [3782] "s__gilvosporeus"
## [3783] "s__sp. ATCC 55076"
## [3784] "s__pleuropneumoniae"
## [3785] "s__massiliana"
## [3786] "s__etli"
## [3787] "s__chloracetimidivorans"
## [3788] "s__vaccae"
## [3789] "s__corrodens"
## [3790] "s__sp. Ap13"
## [3791] "s__sp. NIBRBAC000506063"
## [3792] "s__sp. ESL0405"
## [3793] "s__formatexigens"
## [3794] "s__sp. MTCC 10508"
## [3795] "s__socia"
## [3796] "s__franciscana"
## [3797] "s__sp. MD294"
## [3798] "s__sp. CS13"
## [3799] "s__gozinkensis"
## [3800] "s__catenulatum"
## [3801] "s__infera"
## [3802] "s__marisrubri"
## [3803] "s__sp. MB263"
## [3804] "s__ginsenosidivorans"
## [3805] "s__stercorarium"
## [3806] "s__sp. B1-46"
## [3807] "s__paraoxydans"
## [3808] "s__acetylenica"
## [3809] "s__harbinense"
## [3810] "s__qingshengii"
## [3811] "s__capsici"
## [3812] "s__sp. AntiMn-1"
## [3813] "s__sp. RHBSTW-01013"
## [3814] "s__exovorus"
## [3815] "s__nordii"
## [3816] "s__sp. Yu-01"
## [3817] "s__exfoliatus"
## [3818] "s__dublinensis"
## [3819] "s__suionicum"
## [3820] "s__toebii"
## [3821] "s__sp. CL-1"
## [3822] "s__carbonis"
## [3823] "s__sp. Man26"
## [3824] "s__sp. KBS0722"
## [3825] "s__sp. Z16"
```

```
## [3826] "s__limosus"
## [3827] "s__sp. HDW10"
## [3828] "s__paramesenteroides"
## [3829] "s__ziniensis"
## [3830] "s__alpinus"
## [3831] "s__acnes"
## [3832] "s__beijerinckii"
## [3833] "s__sp. GCEP-101"
## [3834] "s__sp. JS20170427COW"
## [3835] "s__pluripotens"
## [3836] "s__fortis"
## [3837] "s__ostraviense"
## [3838] "s__konkukensis"
## [3839] "s__mutans"
## [3840] "s__sp. YC-JY1"
## [3841] "s__tropici"
## [3842] "s__sp. SL191"
## [3843] "s__mundtii"
## [3844] "s__pseudintermedius"
## [3845] "s__sp. SCSIO 75817"
## [3846] "s__sp. HUAS12"
## [3847] "s__braakii"
## [3848] "s__pacificum"
## [3849] "s__thermoluteolus"
## [3850] "s__sp. YS12"
## [3851] "s__triatomae"
## [3852] "s__centenum"
## [3853] "s__tolerans"
## [3854] "s__sp. RG1"
## [3855] "s__acidaminiphila"
## [3856] "s__ilealis"
## [3857] "s__sp. NM4"
## [3858] "s__sporogenes"
## [3859] "s__sp. PBS-H4"
## [3860] "s__oceanicum"
## [3861] "s__wenshanensis"
## [3862] "s__modesticaldum"
## [3863] "s__shinii"
## [3864] "s__pneumophila"
## [3865] "s__sp. DSM 40868"
## [3866] "s__sp. DG01"
## [3867] "s__endometrii"
## [3868] "s__yuhuli"
## [3869] "s__savannae"
## [3870] "s__sp. BH-3-3-3"
## [3871] "s__infantis"
## [3872] "s__sp. IY07-71"
## [3873] "s__sp. ME-1"
## [3874] "s__vestibularis"
## [3875] "s__bifidum"
## [3876] "s__proteamaculans"
## [3877] "s__holsaticum"
## [3878] "s__ottawaense"
## [3879] "s__goettingensis"
```

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## [3880] "s__sp. 21MFCrub1.1"
## [3881] "s__sp. Marseille-Q6498"
## [3882] "s__tiedjei"
## [3883] "s__lautus"
## [3884] "s__sp. S1-29"
## [3885] "s__mediterraneensis"
## [3886] "s__luminosum"
## [3887] "s__lemurum"
## [3888] "s__phaeolivaceus"
## [3889] "s__sp. JL.03c"
## [3890] "s__sp. S-1144"
## [3891] "s__jogaejeotgali"
## [3892] "s__sp. MC521"
## [3893] "s__lenticrescens"
## [3894] "s__capricolum"
## [3895] "s__sp. Dent CA1/247"
## [3896] "s__xinghaiensis"
## [3897] "s__sp. BIM B-1768"
## [3898] "s__sp. TH136"
## [3899] "s__glycovorans"
## [3900] "s__saliphilus"
## [3901] "s__pentosus"
## [3902] "s__aegosomatissinici"
## [3903] "s__sp. PB12-B1b"
## [3904] "s__sp. YIM 151497"
## [3905] "s__sp. Pop5"
## [3906] "s__hypermegale"
## [3907] "s__caowuchunii"
## [3908] "s__sp. SL2Y3"
## [3909] "s__parafortuitum"
## [3910] "s__cattleyicolor"
## [3911] "s__sp. RHBSTW-00175"
## [3912] "s__isosaccharinicus"
## [3913] "s__minutum"
## [3914] "s__isatidis"
## [3915] "s__sp. BNL1100"
## [3916] "s__acidiceleris"
## [3917] "s__equinus"
## [3918] "s__succinus"
## [3919] "s__sp. D18"
## [3920] "s__sp. Scap07"
## [3921] "s__chubuense"
## [3922] "s__sp. KM1"
## [3923] "s__sp. FDAARGOS_192"
## [3924] "s__sp. BuS5"
## [3925] "s__sulfexigens"
## [3926] "s__vulneris"
## [3927] "s__ovolyticum"
## [3928] "s__trachealis"
## [3929] "s__mitis"
## [3930] "s__sp. KTR9"
## [3931] "s__cronae"
## [3932] "s__sp. AM 3-1-1"
## [3933] "s__sp. J2-20"
```

```
## [3934] "s__caldifontis"
## [3935] "s__licheniformis"
## [3936] "s__kunzii"
## [3937] "s__austroafricanum"
## [3938] "s__cremoris"
## [3939] "s__yatensis"
## [3940] "s__sp. FZFQ2102"
## [3941] "s__sp. HDW12B"
## [3942] "s__lithophora"
## [3943] "s__ferrinatatus"
## [3944] "s__sp. NP310"
## [3945] "s__varians"
## [3946] "s__milleri"
## [3947] "s__sp. FDAARGOS 1247"
## [3948] "s__sp. 24"
## [3949] "s__dinghuense"
## [3950] "s__sp. SB49"
## [3951] "s__sp. Marseille-Q5346"
## [3952] "s__paragordonae"
## [3953] "s__suipulveris"
## [3954] "s__sp. fl3"
## [3955] "s__nauticus"
## [3956] "s__rubellus"
## [3957] "s__sp. 1D1416"
## [3958] "s__oeni"
## [3959] "s__alkaliphila"
## [3960] "s__sp. PAMC21962"
## [3961] "s__alactolyticus"
## [3962] "s__minutus"
## [3963] "s__neptunius"
## [3964] "s__galegae"
## [3965] "s__sp. oral taxon 212"
## [3966] "s__olei"
## [3967] "s__sp. LN180020"
## [3968] "s__drakei"
## [3969] "s__yangtzensis"
## [3970] "s__proteus"
## [3971] "s__meyeri"
## [3972] "s__sp. EMB200-NS6"
## [3973] "s__litorisediminis"
## [3974] "s__gelatinovorus"
## [3975] "s__shibae"
## [3976] "s__coldseepsis"
## [3977] "s__sp. CoE-012-22"
## [3978] "s__banfieldiae"
## [3979] "s__hathewayi"
## [3980] "s__humi"
## [3981] "s__sp. COWG"
## [3982] "s__sp. LKL04"
## [3983] "s__naphthae"
## [3984] "s__xianingshaonis"
## [3985] "s__coprocola"
## [3986] "s__sp. CACIAM 03H1"
## [3987] "s__sp. oral taxon 275"
```

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## [3988] "s__alkalilenta"
## [3989] "s__ingrahamii"
## [3990] "s__heyeri"
## [3991] "s__mutanolyticus"
## [3992] "s__upsaliensis"
## [3993] "s__chitinolyticus"
## [3994] "s__lithotrophicus"
## [3995] "s__amylophilus"
## [3996] "s__acidominimus"
## [3997] "s__cladoniae"
## [3998] "s__sandarakinum"
## [3999] "s__sp. 5116S-27"
## [4000] "s__sp. MCM B-1480"
## [4001] "s__sp. NIES-3974"
## [4002] "s__silvaticum"
## [4003] "s__fairfieldensis"
## [4004] "s__sp. Marseille"
## [4005] "s__piscolens"
## [4006] "s__sp. ESL0690"
## [4007] "s__conspicua"
## [4008] "s__elongatum"
## [4009] "s__sp. 6-C"
## [4010] "s__sp. SSW1-36"
## [4011] "s__sp. KACC 22765"
## [4012] "s__lydicus"
## [4013] "s__sp. R1AF57"
## [4014] "s__azoreducens"
## [4015] "s__oakridgensis"
## [4016] "s__sp. YC-RL4"
## [4017] "s__nakagawai"
## [4018] "s__sp. M1E.F.Ca.ET.045.02.1.1"
## [4019] "s__septicus"
## [4020] "s__sp. 75"
## [4021] "s__sp. 762G35"
## [4022] "s__dadantii"
## [4023] "s__rarisocia"
## [4024] "s__calidirosea"
## [4025] "s__sp. So13.3"
## [4026] "s__sp. Marseille-Q4147"
## [4027] "s__davisii"
## [4028] "s__sp. NJS201"
## [4029] "s__flabilis"
## [4030] "s__dassonvillei"
## [4031] "s__sp. oral taxon 478"
## [4032] "s__cristatus"
## [4033] "s__ferruginea"
## [4034] "s__sp. ALD_SL1"
## [4035] "s__faviae"
## [4036] "s__cholodnii"
## [4037] "s__sp. RPA4-5"
## [4038] "s__hansenii"
## [4039] "s__sp. L-11A"
## [4040] "s__vinaceum"
## [4041] "s__sp. 1.5R"
```

```
## [4042] "s__crocatus"
## [4043] "s__sp. NBSH8"
## [4044] "s__flavida"
## [4045] "s__panareensis"
## [4046] "s__sp. B2-1-8"
## [4047] "s__ectoiniformans"
## [4048] "s__sp. JA-3-3Ab"
## [4049] "s__caccae"
## [4050] "s__sp. SSWR10-1"
## [4051] "s__gordoncarteri"
## [4052] "s__spizizenii"
## [4053] "s__pelargi"
## [4054] "s__sp. N2270"
## [4055] "s__platensis"
## [4056] "s__sp. PAMC25594"
## [4057] "s__sp. Marseille-Q4063"
## [4058] "s__sp. PK3_47"
## [4059] "s__ambifaria"
## [4060] "s__sp. T9N"
## [4061] "s__spiroformis"
## [4062] "s__sp. UFO1"
## [4063] "s__decontaminans"
## [4064] "s__flexneri"
## [4065] "s__dissulfuricans"
## [4066] "s__sp. M190262"
## [4067] "s__arsenitoxydans"
## [4068] "s__mucilaginosa"
## [4069] "s__sp. JBR18"
## [4070] "s__naphthalenovorans"
## [4071] "s__mitsuokai"
## [4072] "s__sp. VKM Ac-2762"
## [4073] "s__sp. DSM 114396"
## [4074] "s__sp. XSG"
## [4075] "s__choanae"
## [4076] "s__sp. SynAce01"
## [4077] "s__messinensis"
## [4078] "s__sp. ES.058"
## [4079] "s__coralloides"
## [4080] "s__aquilae"
## [4081] "s__mojavensis"
## [4082] "s__sp. CCTCC M2018092"
## [4083] "s__sp. WCF-2"
## [4084] "s__cenocepacia"
## [4085] "s__sp. PAMC 21323"
## [4086] "s__sp. C052"
## [4087] "s__lugdunensis"
## [4088] "s__sp. CCBAU 53421"
## [4089] "s__sp. UP202"
## [4090] "s__sp. WH10"
## [4091] "s__mantenii"
## [4092] "s__lignieresii"
## [4093] "s__psychralcaliphila"
## [4094] "s__oxytoca"
## [4095] "s__fistulariae"
```

```
## [4096] "s__mycetoides"
## [4097] "s__wangchenii"
## [4098] "s__hassiacum"
## [4099] "s__valaisiana"
## [4100] "s__atlanticum"
## [4101] "s__sp. ABRD24"
## [4102] "s__meningoseptica"
## [4103] "s__sp. Y-9"
## [4104] "s__nova"
## [4105] "s__caecicola"
## [4106] "s__firmus"
## [4107] "s__endbachense"
## [4108] "s__sp. HUAS 2-6"
## [4109] "s__rwandensis"
## [4110] "s__sp. S02"
## [4111] "s__moraniae"
## [4112] "s__bacilliformis"
## [4113] "s__sp. Y3"
## [4114] "s__sp. NML98-0116"
## [4115] "s__lentus"
## [4116] "s__sp. PSBB067"
## [4117] "s__tagluense"
## [4118] "s__herbarum"
## [4119] "s__sp. DBS9H8"
## [4120] "s__sp. NZP2298"
## [4121] "s__agaricidamnosum"
## [4122] "s__sp. BDGP8"
## [4123] "s__castenholzii"
## [4124] "s__pilosa"
## [4125] "s__Candidatus Aquiluna sp. UB-MaderosW2red"
## [4126] "s__sp. P1Y"
## [4127] "s__marthii"
## [4128] "s__sp. PAMC28650"
## [4129] "s__sp. Pch-M"
## [4130] "s__persica"
## [4131] "s__sp. Aquia_216"
## [4132] "s__marincola"
## [4133] "s__torques-reginae"
## [4134] "s__sp. YMA4"
## [4135] "s__cypripedii"
## [4136] "s__welshimeri"
## [4137] "s__phosphoreum"
## [4138] "s__sakei"
## [4139] "s__sp. ALC3"
## [4140] "s__sp. 364"
## [4141] "s__enteropelogenes"
## [4142] "s__sp. SOS3"
## [4143] "s__striatum"
## [4144] "s__cibaria"
## [4145] "s__sp. PKUAC-SCTA174"
## [4146] "s__multivorum"
## [4147] "s__diestrammenae"
## [4148] "s__peraridilitoris"
## [4149] "s__zengguangii"
```

```
## [4150] "s__stationis"
## [4151] "s__sp. GAS368"
## [4152] "s__sp. YH16040_T"
## [4153] "s__melissae"
## [4154] "s__pronyensis"
## [4155] "s__sp. BS-02"
## [4156] "s__erythrophlei"
## [4157] "s__sp. E2-28"
## [4158] "s__rectiverticillatus"
## [4159] "s__Halalkalibacterium halodurans"
## [4160] "s__sp. MRC013"
## [4161] "s__minutissimum"
## [4162] "s__sp. KD4"
## [4163] "s__sp. CBW1108"
## [4164] "s__steynii"
## [4165] "s__sp. C-145"
## [4166] "s__thymidiniphilus"
## [4167] "s__thermalba"
## [4168] "s__sp. YIM 10"
## [4169] "s__sp. SBC1"
## [4170] "s__inusitata"
## [4171] "s__sp. NEB149"
## [4172] "s__aquarius"
## [4173] "s__croceilyticus"
## [4174] "s__ljungdahlii"
## [4175] "s__boryana"
## [4176] "s__aurulentum"
## [4177] "s__hafniense"
## [4178] "s__celeriflavum"
## [4179] "s__litoris"
## [4180] "s__sp. S6-11"
## [4181] "s__sp. JN-1"
## [4182] "s__raffinolactis"
## [4183] "s__sp. BG8"
## [4184] "s__doosanense"
## [4185] "s__coniformis"
## [4186] "s__sp. SL85"
## [4187] "s__hansupus"
## [4188] "s__sp. DQ12-45-1b"
## [4189] "s__sp. WZN-1"
## [4190] "s__sp. B1-1-8"
## [4191] "s__sp. A1-5"
## [4192] "s__portensis"
## [4193] "s__macginleyi"
## [4194] "s__gigas"
## [4195] "s__sp. ZM23"
## [4196] "s__sp. SL93"
## [4197] "s__mexicana"
## [4198] "s__sp. JZ28"
## [4199] "s__fumaroli"
## [4200] "s__pasteurianum"
## [4201] "s__gotjawalensis"
## [4202] "s__rufum"
## [4203] "s__sp. LRP2-20"
```

```
## [4204] "s__sp. B21-028"
## [4205] "s__fimi"
## [4206] "s__Isorropodon fossajaponicum symbiont"
## [4207] "s__jensenii"
## [4208] "s__sp. SPIII_3"
## [4209] "s__sp. Kera 3"
## [4210] "s__sp. B21-047"
## [4211] "s__sp. EM10"
## [4212] "s__glyciniphilum"
## [4213] "s__postgatei"
## [4214] "s__cereus"
## [4215] "s__cyanobacterium endosymbiont of Epithemia clementina EcSB"
## [4216] "s__aeruginosavorus"
## [4217] "s__sp. zg-Y859"
## [4218] "s__ambystomatis"
## [4219] "s__sp. GS7"
## [4220] "s__sp. 'caverna'"
## [4221] "s__parasanguinis"
## [4222] "s__sp. RS39"
## [4223] "s__sp. WH 8109"
## [4224] "s__panuliri"
## [4225] "s__naganoensis"
## [4226] "s__sophorae"
## [4227] "s__conspicuum"
## [4228] "s__sp. SGAir0954"
## [4229] "s__kefirresidentii"
## [4230] "s__oligofermentans"
## [4231] "s__olivaceus"
## [4232] "s__sp. Y8"
## [4233] "s__sp. MA-2"
## [4234] "s__sp. BP30"
## [4235] "s__elkanii"
## [4236] "s__sp. PB12/4term"
## [4237] "s__sp. NZP2077"
## [4238] "s__lepromatosis"
## [4239] "s__sp. PROS-9-1"
## [4240] "s__rapida"
## [4241] "s__sp. R8"
## [4242] "s__sp. NBAIMH1"
## [4243] "s__altitudinis"
## [4244] "s__glycogenica"
## [4245] "s__sp. LPB0142"
## [4246] "s__limnaea"
## [4247] "s__stagnalis"
## [4248] "s__svalbardensis"
## [4249] "s__sp. JL477"
## [4250] "s__sp. csp3"
## [4251] "s__bilis"
## [4252] "s__sp. RDE2"
## [4253] "s__sp. 170"
## [4254] "s__fraxinea"
## [4255] "s__sp. WS12"
## [4256] "s__sp. DB-40"
## [4257] "s__sabuli"
```

```
## [4258] "s__ehrlichii"
## [4259] "s__sp. P2"
## [4260] "s__sp. KUDC0405"
## [4261] "s__canalis"
## [4262] "s__lactucae"
## [4263] "s__tsukubensis"
## [4264] "s__sp. WF146"
## [4265] "s__sunii"
## [4266] "s__tetani"
## [4267] "s__sp. WKF16"
## [4268] "s__sp. cB07"
## [4269] "s__sp. MFBS3-15"
## [4270] "s__helveticus"
## [4271] "s__cellulolyticum"
## [4272] "s__sp. RAC03"
## [4273] "s__sp. NP-4(2019)"
## [4274] "s__alkalaceticum"
## [4275] "s__activa"
## [4276] "s__oriscaviae"
## [4277] "s__sp. YN"
## [4278] "s__sp. Pch-S"
## [4279] "s__sp. KKS102"
## [4280] "s__sp. Z12"
## [4281] "s__sp. TF02-7"
## [4282] "s__theicola"
## [4283] "s__sp. YB324"
## [4284] "s__gallisepticum"
## [4285] "s__xanthomarina"
## [4286] "s__psittacipulmonis"
## [4287] "s__necator"
## [4288] "s__shigaense"
## [4289] "s__halodurans"
## [4290] "s__sp. XY-2"
## [4291] "s__arilaitensis"
## [4292] "s__dispersa"
## [4293] "s__sp. HH130629-09"
## [4294] "s__arcticus"
## [4295] "s__rhodochrous"
## [4296] "s__sp. ABRD_28"
## [4297] "s__sp. THAF82"
## [4298] "s__bemidjiense"
## [4299] "s__alhagi"
## [4300] "s__sp. 4R-513"
## [4301] "s__sp. DL-VIII"
## [4302] "s__sp. ALC70"
## [4303] "s__sp. SCPEA002"
## [4304] "s__jinghuaiqii"
## [4305] "s__sp. M259"
## [4306] "s__alkylphenolica"
## [4307] "s__sp. MC1862"
## [4308] "s__guangdongensis"
## [4309] "s__neonatale"
## [4310] "s__sp. AJA228-03"
## [4311] "s__roseirectus"
```

```
## [4312] "s__shigelloides"
## [4313] "s__odontolytica"
## [4314] "s__canimorsus"
## [4315] "s__sp. NMCA1"
## [4316] "s__peoriae"
## [4317] "s__timonense"
## [4318] "s__sp. Ricciae_BoGa-3"
## [4319] "s__sp. ESL0790"
## [4320] "s__sp. 2125159857"
## [4321] "s__faecimaris"
## [4322] "s__macleodii"
## [4323] "s__thuringiensis"
## [4324] "s__[Ruminococcus] lactaris"
## [4325] "s__helvum"
## [4326] "s__sp. 24E2"
## [4327] "s__graeca"
## [4328] "s__taurus"
## [4329] "s__polytropus"
## [4330] "s__craniellae"
## [4331] "s__sp. W7"
## [4332] "s__sp. I71"
## [4333] "s__euryhalodurans"
## [4334] "s__corsicus"
## [4335] "s__elizabethae"
## [4336] "s__galactanivorans"
## [4337] "s__fengzijianii"
## [4338] "s__sp. CCGE532"
## [4339] "s__phaeum"
## [4340] "s__restrictus"
## [4341] "s__sp. VKM Ac-2760"
## [4342] "s__campestrisoli"
## [4343] "s__exhalans"
## [4344] "s__leprae"
## [4345] "s__sp. MWH-Spelu-300-X4"
## [4346] "s__gardneri"
## [4347] "s__sp. JY-7876"
## [4348] "s__stuartii"
## [4349] "s__enterica"
## [4350] "s__sp. CBA3102"
## [4351] "s__fastidiosus"
## [4352] "s__rhizogenes"
## [4353] "s__sp. L2-79-05"
## [4354] "s__kroppenstedtii"
## [4355] "s__sp. ST1015"
## [4356] "s__affigens"
## [4357] "s__sp. CS682"
## [4358] "s__scardovii"
## [4359] "s__galeata"
## [4360] "s__ganghwense"
## [4361] "s__ishigakiensis"
## [4362] "s__lavendulae"
## [4363] "s__splanchnicus"
## [4364] "s__sp. UDSM-2020"
## [4365] "s__sp. S16"
```

```
## [4366] "s__grossiae"
## [4367] "s__larrymoorei"
## [4368] "s__sp. 11-B-312"
## [4369] "s__sp. NLF-5-8"
## [4370] "s__proteinivorum"
## [4371] "s__sp. A6099"
## [4372] "s__serpentiformis"
## [4373] "s__giovannonii"
## [4374] "s__sp. HYN0024"
## [4375] "s__sp. MS455"
## [4376] "s__sp. BDJS001"
## [4377] "s__sp. NtRootA1"
## [4378] "s__sp. CB1024"
## [4379] "s__saccharophila"
## [4380] "s__sp. X-1"
## [4381] "s__sp. E4742"
## [4382] "s__tangerina"
## [4383] "s__sp. DMU1"
## [4384] "s__mori"
## [4385] "s__bethesdensis"
## [4386] "s__sabulinigri"
## [4387] "s__sp. KNUC1210"
## [4388] "s__sp. Mg1"
## [4389] "s__obscurus"
## [4390] "s__sp. 1608163"
## [4391] "s__zengyii"
## [4392] "s__luti"
## [4393] "s__sp. SCG-1"
## [4394] "s__sp. C5510"
## [4395] "s__sp. NIBR2454"
## [4396] "s__boletus"
## [4397] "s__cryptoxanthini"
## [4398] "s__thiophilus"
## [4399] "s__radicincitans"
## [4400] "s__sp. K1W22B-7"
## [4401] "s__sp. UASWS1016"
## [4402] "s__rhusiopathiae"
## [4403] "s__sp. T93"
## [4404] "s__sp. KIS68-7"
## [4405] "s__sp. WB94"
## [4406] "s__cryptocerci"
## [4407] "s__sp. CF"
## [4408] "s__binhaiensis"
## [4409] "s__sp. Marseille-Q7828"
## [4410] "s__sp. AAP5"
## [4411] "s__sp. L3-i23"
## [4412] "s__youngiae"
## [4413] "s__sp. FeN2"
## [4414] "s__pinxianii"
## [4415] "s__sp. IHBB 10380"
## [4416] "s__sp. Fw109-5"
## [4417] "s__furnissii"
## [4418] "s__sp. Adler-ghost"
## [4419] "s__canariense"
```

```
## [4420] "s__producens"
## [4421] "s__pontiacus"
## [4422] "s__sp. BJN0003"
## [4423] "s__multipartita"
## [4424] "s__mayonis"
## [4425] "s__roseola"
## [4426] "s__phymatum"
## [4427] "s__sedlakii"
## [4428] "s__micra"
## [4429] "s__sp. OM7"
## [4430] "s__orientis"
## [4431] "s__sp. AONIH1"
## [4432] "s__inkyongensis"
## [4433] "s__xenophagum"
## [4434] "s__sp. sptzw28"
## [4435] "s__sp. ESL0682"
## [4436] "s__carotovorum"
## [4437] "s__sp. CCBAU 51753"
## [4438] "s__lariciata"
## [4439] "s__atrarenae"
## [4440] "s__mediterranei"
## [4441] "s__sp. R24"
## [4442] "s__sp. PIA16"
## [4443] "s__ferrophilus"
## [4444] "s__chlorobenzoica"
## [4445] "s__vulturis"
## [4446] "s__drentensis"
## [4447] "s__sanyensis"
## [4448] "s__hallii"
## [4449] "s__gerontici"
## [4450] "s__sp. SCSIO52902"
## [4451] "s__obscuriglobus"
## [4452] "s__sp. TRM1-10"
## [4453] "s__sp. YIM 151385"
## [4454] "s__cetorum"
## [4455] "s__fucicola"
## [4456] "s__amoebiphila"
## [4457] "s__cellanae"
## [4458] "s__sp. LPB0260"
## [4459] "s__mysorens"
## [4460] "s__xylanus"
## [4461] "s__eburnea"
## [4462] "s__liangshanensis"
## [4463] "s__formicoaceticum"
## [4464] "s__russatus"
```

```
subsetMG %>% ps_filter(AB == "yes") %>% get_taxa_unique("Species") # 2347 different orders for AB treat
```

```
##    [1] "s__sp. LM6"
##    [2] "s__sp. 5116S-3"
##    [3] "s__sp. 32K"
##    [4] "s__sp. CJ74"
##    [5] "s__sp. CR-Ec1"
##    [6] "s__malaysiensis"
```

```
##    [7] "s__leguminosarum"
##    [8] "s__larvae"
##    [9] "s__salina"
##   [10] "s__sp. TY1-4"
##   [11] "s__sp. RR6"
##   [12] "s__mengziensis"
##   [13] "s__"
##   [14] "s__equigenitalium"
##   [15] "s__sp. NEAU-sy36"
##   [16] "s__gei"
##   [17] "s__vestfoldensis"
##   [18] "s__septicum"
##   [19] "s__alkanexedens"
##   [20] "s__sp. D15"
##   [21] "s__sp. THAF1"
##   [22] "s__sphaeroides"
##   [23] "s__luteus"
##   [24] "s__mirabilis"
##   [25] "s__prevotii"
##   [26] "s__testudinis"
##   [27] "s__macrosporus"
##   [28] "s__sp. SCLE84"
##   [29] "s__tepida"
##   [30] "s__salinestris"
##   [31] "s__caldiproteolyticus"
##   [32] "s__difficile"
##   [33] "s__dentium"
##   [34] "s__sp. E76"
##   [35] "s__sp. LQ44"
##   [36] "s__profundi"
##   [37] "s__australis"
##   [38] "s__avium"
##   [39] "s__sp. KSB-10"
##   [40] "s__arboricola"
##   [41] "s__palleroniana"
##   [42] "s__abyssi"
##   [43] "s__qiguomingii"
##   [44] "s__sihwensis"
##   [45] "s__gloriosae"
##   [46] "s__intestini"
##   [47] "s__propionicum"
##   [48] "s__aestuarii"
##   [49] "s__indolicus"
##   [50] "s__ruminicola"
##   [51] "s__haemaphysalidis"
##   [52] "s__sp. 19OD2882"
##   [53] "s__manihotivorum"
##   [54] "s__deleyi"
##   [55] "s__sp. OT10"
##   [56] "s__bestiarum"
##   [57] "s__ulcerans"
##   [58] "s__sp. DTU12.3"
##   [59] "s__vannielii"
##   [60] "s__lutetiensis"
```

```
##   [61] "s__fermentans"
##   [62] "s__ruber"
##   [63] "s__rotai"
##   [64] "s__sp. CCBAU 05631"
##   [65] "s__sp. Y-01"
##   [66] "s__tsuruhatensis"
##   [67] "s__porcitonsillarum"
##   [68] "s__robiniae"
##   [69] "s__sp. PDNC005"
##   [70] "s__acidurici"
##   [71] "s__gryphiswaldense"
##   [72] "s__taklimakanense"
##   [73] "s__parvum"
##   [74] "s__aurantiacus"
##   [75] "s__sp. KBS50"
##   [76] "s__indica"
##   [77] "s__tepidum"
##   [78] "s__salmonicida"
##   [79] "s__sp. B53371"
##   [80] "s__corsica"
##   [81] "s__gilvus"
##   [82] "s__psychrotolerans"
##   [83] "s__sp. SL97"
##   [84] "s__sanguinis"
##   [85] "s__endosymbiont 'TC1' of Trimyema compressum"
##   [86] "s__harei"
##   [87] "s__sp. Aquia_213"
##   [88] "s__seropedicae"
##   [89] "s__sp. 1_2014MBL_MicDiv"
##   [90] "s__regensburgei"
##   [91] "s__mobilis"
##   [92] "s__extorquens"
##   [93] "s__aurantiacum"
##   [94] "s__dioxanivorans"
##   [95] "s__sicerae"
##   [96] "s__sp. cx-51"
##   [97] "s__polymyxa"
##   [98] "s__planticola"
##   [99] "s__lutea"
##  [100] "s__indicum"
##  [101] "s__saerimneri"
##  [102] "s__griseocarneus"
##  [103] "s__sp. YIM 121038"
##  [104] "s__roseus"
##  [105] "s__microcysteis"
##  [106] "s__sp. PL-2018"
##  [107] "s__succinifaciens"
##  [108] "s__sunshinyii"
##  [109] "s__sp. SK17"
##  [110] "s__insidiosa"
##  [111] "s__thermophilum"
##  [112] "s__sp. GAS474"
##  [113] "s__denitrificans"
##  [114] "s__sp. W1SF4"
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## [115] "s__sp. 19GGS1-52"
## [116] "s__ianthinogenes"
## [117] "s__sp. R3"
## [118] "s__infantis"
## [119] "s__sp. TCL240-02"
## [120] "s__changnyeongensis"
## [121] "s__terpenica"
## [122] "s__wadenswilerensis"
## [123] "s__thiooxidans"
## [124] "s__stuttgartiensis"
## [125] "s__bovigenitalium"
## [126] "s__audaxviator"
## [127] "s__sp. MX-AZ03"
## [128] "s__mitochondrii"
## [129] "s__confusa"
## [130] "s__aalborgensis"
## [131] "s__thiooxydans"
## [132] "s__carolinensis"
## [133] "s__sp. LMS6"
## [134] "s__hiranonis"
## [135] "s__sp. JY-X169"
## [136] "s__syrphidicola"
## [137] "s__lujinxingii"
## [138] "s__suranareeae"
## [139] "s__sp. Wa41.01b-1"
## [140] "s__sputigena"
## [141] "s__defluvii"
## [142] "s__nasimurium"
## [143] "s__sp. zrk46"
## [144] "s__sp. YS"
## [145] "s__sp. J2-11"
## [146] "s__musculi"
## [147] "s__iowae"
## [148] "s__fungivorans"
## [149] "s__vitis"
## [150] "s__nodosus"
## [151] "s__sedimenticola"
## [152] "s__gobiensis"
## [153] "s__bremense"
## [154] "s__stearothermophilus"
## [155] "s__sp. FHR47"
## [156] "s__sp. 5317J-9"
## [157] "s__sp. KH32C"
## [158] "s__aquaticus"
## [159] "s__rhamnosus"
## [160] "s__lacus"
## [161] "s__terrae"
## [162] "s__minervae"
## [163] "s__pigmentatum"
## [164] "s__oceani"
## [165] "s__sp. 3B(2020)"
## [166] "s__armeniacus"
## [167] "s__chengjingii"
## [168] "s__ponti"
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## [169] "s__sp. SH-PL14"
## [170] "s__liaowanqingii"
## [171] "s__amarae"
## [172] "s__gelatinosus"
## [173] "s__dokdonensis"
## [174] "s__mesenteroides"
## [175] "s__intestinalis"
## [176] "s__agilis"
## [177] "s__marina"
## [178] "s__agri"
## [179] "s__cuenoti"
## [180] "s__pyridinivorans"
## [181] "s__sp. SCSIO 61187"
## [182] "s__caldus"
## [183] "s__sulfonylureivorans"
## [184] "s__parva"
## [185] "s__tropicus"
## [186] "s__crevioricanis"
## [187] "s__broussonetiae"
## [188] "s__sp. oral taxon 807"
## [189] "s__alboniger"
## [190] "s__baltica"
## [191] "s__sp. FB-5"
## [192] "s__uli"
## [193] "s__viscericola"
## [194] "s__sp. HUAS 5"
## [195] "s__longa"
## [196] "s__glycinifermentans"
## [197] "s__gasseri"
## [198] "s__hadrus"
## [199] "s__sp. SM18"
## [200] "s__sp. TC1"
## [201] "s__sp. Allo2"
## [202] "s__condimenti"
## [203] "s__sp. WY228"
## [204] "s__ficus"
## [205] "s__sp. SCSIO 43088"
## [206] "s__sp. SD9660Na"
## [207] "s__sp. TS-1"
## [208] "s__radiophilus"
## [209] "s__sp. OMZ 787"
## [210] "s__coli"
## [211] "s__oculi"
## [212] "s__sp. NIES-981"
## [213] "s__circulans"
## [214] "s__phyllanthi"
## [215] "s__thailandicus"
## [216] "s__sp. I507"
## [217] "s__sp. ESL0695"
## [218] "s__sp. INBF002"
## [219] "s__pedis"
## [220] "s__punjabense"
## [221] "s__ginsenosidimutans"
## [222] "s__Candidatus Sodalis pierantonius"
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## [223] "s__denticola"
## [224] "s__pakistanensis"
## [225] "s__sp. ZJ405"
## [226] "s__nataicola"
## [227] "s__amylolyticus"
## [228] "s__dentocariosa"
## [229] "s__timonensis"
## [230] "s__protophormiae"
## [231] "s__sp. ESL0732"
## [232] "s__crassostreae"
## [233] "s__rubrum"
## [234] "s__pabuli"
## [235] "s__sp. D3"
## [236] "s__sp. YJ01"
## [237] "s__sp. 12200R-103"
## [238] "s__melaninogenica"
## [239] "s__sp. 2438"
## [240] "s__siamensis"
## [241] "s__jinjuensis"
## [242] "s__pyogenes"
## [243] "s__phytohabitans"
## [244] "s__sp. BSN-002"
## [245] "s__atlanticum"
## [246] "s__pseudolongum"
## [247] "s__filamentosa"
## [248] "s__sp. HTF-F"
## [249] "s__acetylenivorans"
## [250] "s__sp. Marseille-Q4385"
## [251] "s__brevis"
## [252] "s__bryantii"
## [253] "s__sp. AP-Jannik-300A-C4"
## [254] "s__oligotrophicus"
## [255] "s__sedentarius"
## [256] "s__ruminantium"
## [257] "s__thermophilus"
## [258] "s__rhizoryzae"
## [259] "s__entomophila"
## [260] "s__sp. SCSIO 43204"
## [261] "s__sp. CA-103260"
## [262] "s__aliphaticivorans"
## [263] "s__butyriciproducens"
## [264] "s__ginsengisoli"
## [265] "s__salsilacus"
## [266] "s__albertii"
## [267] "s__variabile"
## [268] "s__urealyticum"
## [269] "s__divergens"
## [270] "s__sp. SY8519"
## [271] "s__sp. ART55/1"
## [272] "s__lutimineralis"
## [273] "s__sp. PAMC 26628"
## [274] "s__cortegadensis"
## [275] "s__paragallinarum"
## [276] "s__nishinomiyaensis"
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## [277] "s__sp. AP4-R1"
## [278] "s__sp. SVR"
## [279] "s__anaerophila"
## [280] "s__sp. M54"
## [281] "s__solani"
## [282] "s__alaskensis"
## [283] "s__cryaerophilus"
## [284] "s__maiorica"
## [285] "s__salarius"
## [286] "s__cedrina"
## [287] "s__sp. oral taxon 920"
## [288] "s__panis"
## [289] "s__sp. KU26590"
## [290] "s__sp. resist"
## [291] "s__viridans"
## [292] "s__moriokaense"
## [293] "s__cicadellinicola"
## [294] "s__aestuariivivum"
## [295] "s__brennaborense"
## [296] "s__sp. fd1-xmd"
## [297] "s__resinovorans"
## [298] "s__baldaniorum"
## [299] "s__caldoxylosilyticus"
## [300] "s__sp. oral taxon 126"
## [301] "s__chitae"
## [302] "s__sp. dk3624"
## [303] "s__sp. CT06"
## [304] "s__sp. AS-1"
## [305] "s__alkaliphilum"
## [306] "s__yuyongxinii"
## [307] "s__sp. 17 mud 1-3"
## [308] "s__tokaiense"
## [309] "s__bovis"
## [310] "s__frisingensis"
## [311] "s__adhaerens"
## [312] "s__pontis"
## [313] "s__insolitus"
## [314] "s__sp. IE-0392"
## [315] "s__sp. AA4"
## [316] "s__marinus"
## [317] "s__funiformis"
## [318] "s__sp. T21"
## [319] "s__sp. MSJ-33"
## [320] "s__sp. QXT-31"
## [321] "s__enoeca"
## [322] "s__brassicae"
## [323] "s__plakortidis"
## [324] "s__wilhelmae"
## [325] "s__citri"
## [326] "s__sp. SP2"
## [327] "s__sp. SFB-rat-Yit"
## [328] "s__sp. 31-12"
## [329] "s__paragasseri"
## [330] "s__pseudomultivorans"
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## [331] "s__kanbiaonis"
## [332] "s__riparius"
## [333] "s__sp. JS666"
## [334] "s__subtilis"
## [335] "s__taeniospiralis"
## [336] "s__stomatis"
## [337] "s__falkenbergense"
## [338] "s__radicidentis"
## [339] "s__sp. MZ1T"
## [340] "s__niveus"
## [341] "s__halelectricus"
## [342] "s__spongiae"
## [343] "s__sp. SMC-4"
## [344] "s__sp. 313"
## [345] "s__dioscoreae"
## [346] "s__testaceum"
## [347] "s__sp. KU28468"
## [348] "s__deserti"
## [349] "s__aerofaciens"
## [350] "s__sp. T7-7"
## [351] "s__suffuscus"
## [352] "s__anyangense"
## [353] "s__sp. ATCC 8456"
## [354] "s__soli"
## [355] "s__amylovorus"
## [356] "s__rodentium"
## [357] "s__leadbetteri"
## [358] "s__jeikeium"
## [359] "s__filiformis"
## [360] "s__gallolyticus"
## [361] "s__sagamiensis"
## [362] "s__sp. HWE-109"
## [363] "s__bryophytorum"
## [364] "s__chitinilytica"
## [365] "s__kloosii"
## [366] "s__urativorans"
## [367] "s__intestinale"
## [368] "s__ptyseos"
## [369] "s__megaterium"
## [370] "s__siliguriense"
## [371] "s__binotii"
## [372] "s__vulgaris"
## [373] "s__ginsenosidivorax"
## [374] "s__sp. HUAS 3"
## [375] "s__sp. PCC 6312"
## [376] "s__novalis"
## [377] "s__sp. WMMA1423"
## [378] "s__kerstersii"
## [379] "s__albida"
## [380] "s__steedae"
## [381] "s__parmense"
## [382] "s__violascens"
## [383] "s__sp. Y33"
## [384] "s__sp. SDN3"
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## [385] "s__liquoris"
## [386] "s__subterraneus"
## [387] "s__kingae"
## [388] "s__coprophilus"
## [389] "s__tropica"
## [390] "s__kondratievae"
## [391] "s__sp. TUM22785"
## [392] "s__riyadhense"
## [393] "s__thermoglucosidasius"
## [394] "s__caledoniensis"
## [395] "s__sp. ZAC14D2_NAIMI4_7"
## [396] "s__diversum"
## [397] "s__sudanensis"
## [398] "s__taiwanensis"
## [399] "s__scoriae"
## [400] "s__diernhoferi"
## [401] "s__dendaii"
## [402] "s__caeni"
## [403] "s__sp. Arg-1"
## [404] "s__sp. NA02950"
## [405] "s__sp. zg-1228"
## [406] "s__saguini"
## [407] "s__sp. LW097"
## [408] "s__biformata"
## [409] "s__sp. S465"
## [410] "s__sp. KCTC 42545"
## [411] "s__sp. zg1085"
## [412] "s__sp. N1846"
## [413] "s__sp. PP1Y"
## [414] "s__sp. ZRK36"
## [415] "s__perfringens"
## [416] "s__lenta"
## [417] "s__Candidatus Filomicrobium marinum"
## [418] "s__hiltneri"
## [419] "s__champanellensis"
## [420] "s__uraniireducens"
## [421] "s__terrifontis"
## [422] "s__copri"
## [423] "s__cottewii"
## [424] "s__constellatus"
## [425] "s__imitans"
## [426] "s__muciniphila"
## [427] "s__sp. SGAir0287"
## [428] "s__concisus"
## [429] "s__acidaminovorans"
## [430] "s__lwoffii"
## [431] "s__sp. RF6"
## [432] "s__elongatus"
## [433] "s__fragi"
## [434] "s__sp. ESL0769"
## [435] "s__keddieii"
## [436] "s__antranikianii"
## [437] "s__radingae"
## [438] "s__mercurii"
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## [439] "s__huaxiensis"
## [440] "s__gauvreauii"
## [441] "s__ammoniagenes"
## [442] "s__thermautotrophica"
## [443] "s__sp. BT18"
## [444] "s__fusiformis"
## [445] "s__sp. MLAF003"
## [446] "s__xyli"
## [447] "s__quercinecans"
## [448] "s__sp. HUAS 11-8"
## [449] "s__oleivorans"
## [450] "s__acidisoli"
## [451] "s__luhongzhouii"
## [452] "s__zhejiangensis"
## [453] "s__radioresistens"
## [454] "s__stutzeri"
## [455] "s__sp. HTCC2170"
## [456] "s__mangrovi"
## [457] "s__gerenzanensis"
## [458] "s__debuckii"
## [459] "s__pigrum"
## [460] "s__koreensis"
## [461] "s__hilgardii"
## [462] "s__nedwellii"
## [463] "s__flavus"
## [464] "s__lipocalidus"
## [465] "s__lusitana"
## [466] "s__pinnipediorum"
## [467] "s__radiotolerans"
## [468] "s__sp. KUDC1026"
## [469] "s__xylanisolvens"
## [470] "s__sp. I4-3-84"
## [471] "s__nigrescens"
## [472] "s__halophila"
## [473] "s__sediminis"
## [474] "s__oryzae"
## [475] "s__sp. NAK00032"
## [476] "s__acetotolerans"
## [477] "s__krulwichiae"
## [478] "s__thermophila"
## [479] "s__piscis"
## [480] "s__aggregans"
## [481] "s__sticklandii"
## [482] "s__sp. GIMC2001"
## [483] "s__coryniformis"
## [484] "s__barguzinensis"
## [485] "s__sp. SUK 48"
## [486] "s__sp. AK26"
## [487] "s__sp. S4.7"
## [488] "s__variicola"
## [489] "s__aerolatus"
## [490] "s__accolens"
## [491] "s__Verrucosispora sp. WMMD573"
## [492] "s__iners"
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## [493] "s__sp. KSW4-10"
## [494] "s__furukawaii"
## [495] "s__sp. wkB8"
## [496] "s__clara"
## [497] "s__guaymasensis"
## [498] "s__benzenivorans"
## [499] "s__panisapium"
## [500] "s__portuensis"
## [501] "s__sp. XGS7"
## [502] "s__woosongensis"
## [503] "s__amylolytica"
## [504] "s__carnosus"
## [505] "s__sp. GSS17"
## [506] "s__protaetiae"
## [507] "s__nuruki"
## [508] "s__sp. 32O-W"
## [509] "s__propionicus"
## [510] "s__antarctica"
## [511] "s__ludwigii"
## [512] "s__kutscheri"
## [513] "s__putida"
## [514] "s__asteroides"
## [515] "s__ferrooxidans"
## [516] "s__aquimaris"
## [517] "s__pseudoperiodonticum"
## [518] "s__vandammei"
## [519] "s__crispatus"
## [520] "s__sp. MMS16-BH015"
## [521] "s__persicina"
## [522] "s__futsaii"
## [523] "s__gaoshouyii"
## [524] "s__callunae"
## [525] "s__sp. 155"
## [526] "s__sp. Lep1P3"
## [527] "s__zoogleoformans"
## [528] "s__psoromatis"
## [529] "s__sp. H3OR-01"
## [530] "s__celer"
## [531] "s__chocolatum"
## [532] "s__shahii"
## [533] "s__thermocarboxydus"
## [534] "s__indistinctus"
## [535] "s__watsonii"
## [536] "s__alkaliphilus"
## [537] "s__inaquosorum"
## [538] "s__sp. PS1209"
## [539] "s__caribensis"
## [540] "s__glucanolyticus"
## [541] "s__nitrativorans"
## [542] "s__cyriacigeorgica"
## [543] "s__panacisegetis"
## [544] "s__argenteus"
## [545] "s__sp. QHH-9511"
## [546] "s__sp. HKS 07"
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## [547] "s__moscoviensis"
## [548] "s__actinocoloniiforme"
## [549] "s__coriaceae"
## [550] "s__michiganensis"
## [551] "s__sp. BRM-1"
## [552] "s__Candidatus Thiodictyon syntrophicum"
## [553] "s__papyrosolvens"
## [554] "s__anthracis"
## [555] "s__dentiae"
## [556] "s__sp. PV034"
## [557] "s__manihotivorans"
## [558] "s__proteoclasticus"
## [559] "s__sichuanensis"
## [560] "s__limicola"
## [561] "s__paradisiaca"
## [562] "s__indicoceani"
## [563] "s__okcheonensis"
## [564] "s__maricopensis"
## [565] "s__sp. SCR221107"
## [566] "s__acidovorans"
## [567] "s__dalangtanensis"
## [568] "s__sp. S13"
## [569] "s__heliothermus"
## [570] "s__sp. BHT-5-2"
## [571] "s__portus"
## [572] "s__halophilus"
## [573] "s__sp. nov. GSS16"
## [574] "s__producta"
## [575] "s__mesophilus"
## [576] "s__commune"
## [577] "s__sp. 5B5"
## [578] "s__casseliflavus"
## [579] "s__thermarum"
## [580] "s__gelatinilyticus"
## [581] "s__aurum"
## [582] "s__bolteae"
## [583] "s__frequens"
## [584] "s__algicola"
## [585] "s__irradiatisoli"
## [586] "s__sp. CdTB01"
## [587] "s__massiliensis"
## [588] "s__nakazawae"
## [589] "s__qintianiae"
## [590] "s__seeligeri"
## [591] "s__oxydans"
## [592] "s__dichloroeliminans"
## [593] "s__formosensis"
## [594] "s__sp. KNUC1026"
## [595] "s__peruense"
## [596] "s__sp. NBC_00162"
## [597] "s__homolactica"
## [598] "s__brevitalea"
## [599] "s__oris"
## [600] "s__saccharobutylicum"
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## [601] "s__agarivorans"
## [602] "s__coccineus"
## [603] "s__sp. FeAm09"
## [604] "s__sp. RD1"
## [605] "s__sp. MNS18"
## [606] "s__freundii"
## [607] "s__sp. PET-29"
## [608] "s__erythreum"
## [609] "s__hydrogenophilus"
## [610] "s__sp. NW-56"
## [611] "s__alba"
## [612] "s__aubagnense"
## [613] "s__ytuae"
## [614] "s__sp. 113-1-2"
## [615] "s__sp. AWRP"
## [616] "s__fortuitum"
## [617] "s__cynos"
## [618] "s__fuchuensis"
## [619] "s__lavamentivorans"
## [620] "s__sp. Gsoil 351"
## [621] "s__cashew"
## [622] "s__ciconiae"
## [623] "s__sp. E85"
## [624] "s__aliiformigenes"
## [625] "s__sp. LPB0304"
## [626] "s__sp. SGAir0570"
## [627] "s__sp. TPU 3598"
## [628] "s__coleopterorum"
## [629] "s__harbinensis"
## [630] "s__crossotus"
## [631] "s__sp. PA-3-X8"
## [632] "s__sp. I3-3-89"
## [633] "s__pulmonis"
## [634] "s__sp. NJN-50"
## [635] "s__sp. SL48"
## [636] "s__delbrueckii"
## [637] "s__fastidiosum"
## [638] "s__aquilus"
## [639] "s__animalis"
## [640] "s__aureus"
## [641] "s__sp. ZAC14D2_NAIMI4_6"
## [642] "s__piscinae"
## [643] "s__sp. S8"
## [644] "s__alni"
## [645] "s__eutactus"
## [646] "s__sp. BIHB 4019"
## [647] "s__pumilus"
## [648] "s__fascians"
## [649] "s__tundricola"
## [650] "s__aeolianus"
## [651] "s__oralis"
## [652] "s__daejeonensis"
## [653] "s__sp. RM10537"
## [654] "s__sp. mosi_1"
```

```
## [655] "s__sp. Hama-1"
## [656] "s__ossetica"
## [657] "s__johnsonii"
## [658] "s__fragariae"
## [659] "s__megalosphaeroides"
## [660] "s__tuberculostearicum"
## [661] "s__sp. CBA3647"
## [662] "s__otitidiscaviarum"
## [663] "s__sp. DG15C"
## [664] "s__genomosp. 9"
## [665] "s__calidifontis"
## [666] "s__sp. BJA-103"
## [667] "s__thiophilum"
## [668] "s__sp. I52.16.1"
## [669] "s__kefiranofaciens"
## [670] "s__garvieae"
## [671] "s__coralli"
## [672] "s__sp. XCS3"
## [673] "s__sp. JZ16"
## [674] "s__sp. WL3"
## [675] "s__fergusonii"
## [676] "s__viridis"
## [677] "s__[Ruminococcus] torques"
## [678] "s__californiensis"
## [679] "s__sp. S132"
## [680] "s__violaceinigra"
## [681] "s__baarsii"
## [682] "s__sp. PK01"
## [683] "s__tunisiensis"
## [684] "s__ganghwensis"
## [685] "s__paraseoulense"
## [686] "s__pituitosa"
## [687] "s__sp. E13-17"
## [688] "s__festucae"
## [689] "s__inquinata"
## [690] "s__phaseoli"
## [691] "s__gallinarum"
## [692] "s__chengduensis"
## [693] "s__caoxuetaonis"
## [694] "s__sp. WMMD882"
## [695] "s__anthropi"
## [696] "s__sp. URB8-2"
## [697] "s__gaofuii"
## [698] "s__pulveris"
## [699] "s__kefiri"
## [700] "s__chromogenes"
## [701] "s__sp. THAF27"
## [702] "s__sp. JQ2195"
## [703] "s__sp. 9128"
## [704] "s__testudinoris"
## [705] "s__dehalogenans"
## [706] "s__pickettii"
## [707] "s__aminophilus"
## [708] "s__kaempferiae"
```

```
## [709] "s__sp. FSL R7-0331"
## [710] "s__xylosus"
## [711] "s__sp. SMJS2"
## [712] "s__lovleyi"
## [713] "s__baratii"
## [714] "s__rubi"
## [715] "s__borealis"
## [716] "s__asparagiformis"
## [717] "s__mucosa"
## [718] "s__tanashiensis"
## [719] "s__salivarius"
## [720] "s__sp. OE 28.3"
## [721] "s__sphenoides"
## [722] "s__agamarum"
## [723] "s__africae"
## [724] "s__umbonata"
## [725] "s__radiopugnans"
## [726] "s__apisilvae"
## [727] "s__sp. J315"
## [728] "s__buecherae"
## [729] "s__sp. GAM44"
## [730] "s__rosea"
## [731] "s__formigenes"
## [732] "s__pacaensis"
## [733] "s__sp. AD91A"
## [734] "s__resistens"
## [735] "s__stercoris"
## [736] "s__nenjiangensis"
## [737] "s__drozdowiczii"
## [738] "s__pulmonicola"
## [739] "s__sp. G2S3"
## [740] "s__sp. SL250"
## [741] "s__quasipneumoniae"
## [742] "s__sp. 107-1"
## [743] "s__cloacae"
## [744] "s__warabiya"
## [745] "s__nigra"
## [746] "s__sp. WAC00303"
## [747] "s__sp. R56"
## [748] "s__carbinoliphilus"
## [749] "s__mucilaginosus"
## [750] "s__thermosuccinogenes"
## [751] "s__elongata"
## [752] "s__sp. NBH87"
## [753] "s__espanaensis"
## [754] "s__magna"
## [755] "s__sp. FDAARGOS 1241"
## [756] "s__Candidatus Protofrankia datiscae"
## [757] "s__albidus"
## [758] "s__paludis"
## [759] "s__somerae"
## [760] "s__xylosoxidans"
## [761] "s__indicus"
## [762] "s__hominis"
```

```
## [763] "s__dysgalactiae"
## [764] "s__sp. LQ25"
## [765] "s__sp. RTd22"
## [766] "s__sp. Jing01"
## [767] "s__rivuli"
## [768] "s__allomyrinae"
## [769] "s__azurea"
## [770] "s__coagulans"
## [771] "s__phytophila"
## [772] "s__sp. DH3716P"
## [773] "s__aminovorans"
## [774] "s__atlanticus"
## [775] "s__haemolytica"
## [776] "s__sp. FDAARGOS 1415"
## [777] "s__metalliredigens"
## [778] "s__bombintestini"
## [779] "s__sp. RC67"
## [780] "s__syringae group genomosp. 7"
## [781] "s__konosiri"
## [782] "s__equorum"
## [783] "s__mediterranea"
## [784] "s__sp. THAF12"
## [785] "s__glycaniphila"
## [786] "s__caseolyticus"
## [787] "s__zosterae"
## [788] "s__osloensis"
## [789] "s__pasteurii"
## [790] "s__intracellularis"
## [791] "s__bifermentans"
## [792] "s__acetigenes"
## [793] "s__gingivalis"
## [794] "s__sp. WMMA1947"
## [795] "s__chauvoei"
## [796] "s__venezuelae"
## [797] "s__arginini"
## [798] "s__aureoverticillatus"
## [799] "s__sp. WMMD812"
## [800] "s__hongkongensis"
## [801] "s__baengnokdamensis"
## [802] "s__sp. OT7"
## [803] "s__sp. FDAARGOS 1409"
## [804] "s__abscessus"
## [805] "s__sp. JM1"
## [806] "s__sp. MR_MD2014"
## [807] "s__sp. YPW1"
## [808] "s__phytofermentans"
## [809] "s__[Clostridium] colinum"
## [810] "s__chenweiae"
## [811] "s__metallilatus"
## [812] "s__sp. CX169"
## [813] "s__pnomenusa"
## [814] "s__pseudoxylosus"
## [815] "s__ferrireducens"
## [816] "s__echinicola"
```

```
## [817] "s__abortibovis"
## [818] "s__sp. QL22"
## [819] "s__autotrophicum"
## [820] "s__phocaeense"
## [821] "s__alcaligenes"
## [822] "s__sp. NSJ-69"
## [823] "s__cervicalis"
## [824] "s__sp. ESL0785"
## [825] "s__xylanophilus"
## [826] "s__vulnificus"
## [827] "s__cinaedi"
## [828] "s__rimosus"
## [829] "s__oleovorans"
## [830] "s__sp. CB1650"
## [831] "s__mucosae"
## [832] "s__sp. INOP01"
## [833] "s__sp. WL1"
## [834] "s__echinospora"
## [835] "s__actuosus"
## [836] "s__sp. D2"
## [837] "s__cellulans"
## [838] "s__lutrae"
## [839] "s__pristinaespiralis"
## [840] "s__xylaniphila"
## [841] "s__phagedenis"
## [842] "s__brevissima"
## [843] "s__ignavus"
## [844] "s__microaerophilus"
## [845] "s__halocryophilus"
## [846] "s__sp. FDAARGOS_375"
## [847] "s__sp. WB-2"
## [848] "s__himalayensis"
## [849] "s__tanakiae"
## [850] "s__innocua"
## [851] "s__rhodesiae"
## [852] "s__pectinilyticus"
## [853] "s__richardii"
## [854] "s__candidum"
## [855] "s__temperans"
## [856] "s__violaceusniger"
## [857] "s__sp. KACC 23028"
## [858] "s__atlantisensis"
## [859] "s__sp. NRS527"
## [860] "s__sobrinus"
## [861] "s__vaginalis"
## [862] "s__vicinigordonae"
## [863] "s__sp. YPD9-1"
## [864] "s__melonis"
## [865] "s__pumilum"
## [866] "s__toyakuensis"
## [867] "s__sp. 3H"
## [868] "s__luteola"
## [869] "s__sp. CKK8"
## [870] "s__acetoxydans"
```

```
## [871] "s__sp. CCB-MM3"
## [872] "s__malmoense"
## [873] "s__clausii"
## [874] "s__eggerthii"
## [875] "s__flava"
## [876] "s__sp. THAF30"
## [877] "s__axanthum"
## [878] "s__sp. HBX-1"
## [879] "s__sp. AH1"
## [880] "s__towneri"
## [881] "s__flexa"
## [882] "s__pseudogrignonensis"
## [883] "s__Blochmannia endosymbiont of Polyrhachis (Hedomyrma) turneri"
## [884] "s__poaceiphila"
## [885] "s__carniphilus"
## [886] "s__methoxysyntrophicus"
## [887] "s__capnotolerans"
## [888] "s__diazotrophicus"
## [889] "s__sp. SL47"
## [890] "s__vincentii"
## [891] "s__sp. WS11"
## [892] "s__sp. G01H"
## [893] "s__simplex"
## [894] "s__thermoresistibile"
## [895] "s__brasilensis"
## [896] "s__zhachilii"
## [897] "s__cytotoxicus"
## [898] "s__saxobsidens"
## [899] "s__vaccinii"
## [900] "s__sp. H121"
## [901] "s__daltonii"
## [902] "s__aquaticum"
## [903] "s__humicireducens"
## [904] "s__genisteinicus"
## [905] "s__pentosaceus"
## [906] "s__degensii"
## [907] "s__warneri"
## [908] "s__blattae"
## [909] "s__wieringae"
## [910] "s__crateris"
## [911] "s__senegalensis"
## [912] "s__paucivorans"
## [913] "s__sp. 3214.6"
## [914] "s__botulinum"
## [915] "s__composti"
## [916] "s__sp. MC1825"
## [917] "s__incomptus"
## [918] "s__lactatiformans"
## [919] "s__multitudinisentens"
## [920] "s__urinaeequi"
## [921] "s__sp. P6W"
## [922] "s__lichenicola"
## [923] "s__Verrucosispora sp. WMMD1129"
## [924] "s__sp. AGMB13025"
```

```
## [925] "s__minnesotensis"
## [926] "s__paludicola"
## [927] "s__fermenticellae"
## [928] "s__heliotrinireducens"
## [929] "s__verrucosospora"
## [930] "s__rhamnosivorans"
## [931] "s__helveticus"
## [932] "s__callanderi"
## [933] "s__aerodenitrificans"
## [934] "s__tertiaricarbonis"
## [935] "s__sera"
## [936] "s__felsineum"
## [937] "s__sp. AR10"
## [938] "s__sp. M28"
## [939] "s__clevelandensis"
## [940] "s__sp. MB-3u-03"
## [941] "s__sp. HF-162"
## [942] "s__newyorkensis"
## [943] "s__anaerobius"
## [944] "s__asoensis"
## [945] "s__sp. 'AMD consortium'"
## [946] "s__lydicamycinicus"
## [947] "s__phasianinus"
## [948] "s__alsatica"
## [949] "s__schaalii"
## [950] "s__cadmiisoli"
## [951] "s__sp. 21SJ11W-1"
## [952] "s__endophyticus"
## [953] "s__setae"
## [954] "s__chongii"
## [955] "s__phragmitis"
## [956] "s__muris"
## [957] "s__hippikon"
## [958] "s__thermocellus"
## [959] "s__sp. Z2-YC6860"
## [960] "s__spormannii"
## [961] "s__sp. H1-D42"
## [962] "s__hoggarensis"
## [963] "s__sp. J780"
## [964] "s__sp. CBA3646"
## [965] "s__sp. FXJ1.172"
## [966] "s__novella"
## [967] "s__ampullae"
## [968] "s__sp. B7740"
## [969] "s__dubosii"
## [970] "s__porci"
## [971] "s__sp. KMM 9044"
## [972] "s__sp. N12"
## [973] "s__bacteriovorus"
## [974] "s__sp. AA-38"
## [975] "s__pseudolwoffii"
## [976] "s__sp. B01"
## [977] "s__otitidis"
## [978] "s__hordei"
```

```
##  [979] "s__eutropha"
##  [980] "s__haemolyticus"
##  [981] "s__chonburiensis"
##  [982] "s__sp. BN140058"
##  [983] "s__sp. AN1"
##  [984] "s__ampelinum"
##  [985] "s__thetaiotaomicron"
##  [986] "s__sp. KB-1"
##  [987] "s__sordellii"
##  [988] "s__sp. L6-1"
##  [989] "s__sp. WH15"
##  [990] "s__argentinense"
##  [991] "s__ferus"
##  [992] "s__sp. JXJ CY 41"
##  [993] "s__alkanivorans"
##  [994] "s__amazonense"
##  [995] "s__sp. SAHP1"
##  [996] "s__sp. JSBI002"
##  [997] "s__fulvum"
##  [998] "s__hexanoica"
##  [999] "s__sp. Arc7-R13"
## [1000] "s__sp. PP30"
## [1001] "s__pestifer"
## [1002] "s__sp. HS6"
## [1003] "s__corallicola"
## [1004] "s__sp. CB01881"
## [1005] "s__sp. B32"
## [1006] "s__thermoacetica"
## [1007] "s__parvatiensis"
## [1008] "s__sp. ZS110521"
## [1009] "s__maris"
## [1010] "s__brockianus"
## [1011] "s__flavum"
## [1012] "s__segnis"
## [1013] "s__sanguinicola"
## [1014] "s__silvanus"
## [1015] "s__amylolyticum"
## [1016] "s__kluyveri"
## [1017] "s__sp. USTB-05"
## [1018] "s__australiense"
## [1019] "s__acidipiscis"
## [1020] "s__simulans"
## [1021] "s__apicola"
## [1022] "s__faecigallinarum"
## [1023] "s__sp. FSL P4-0081"
## [1024] "s__murinus"
## [1025] "s__infantarius"
## [1026] "s__cellobiosedens"
## [1027] "s__gelidum"
## [1028] "s__herbilytica"
## [1029] "s__faecium"
## [1030] "s__pasteurianus"
## [1031] "s__sp. SFB-mouse-NL"
## [1032] "s__sp. TT6"
```

```
## [1033] "s__sp. oral taxon 136"
## [1034] "s__sp. RA8"
## [1035] "s__sp. CIB 2401"
## [1036] "s__sp. YM1"
## [1037] "s__adecarboxylata"
## [1038] "s__ovatus"
## [1039] "s__hattorii"
## [1040] "s__centrodinii"
## [1041] "s__flaccumfaciens"
## [1042] "s__beijingensis"
## [1043] "s__lemovicicum"
## [1044] "s__onderdonkii"
## [1045] "s__sp. VKM Ac-2804"
## [1046] "s__faecis"
## [1047] "s__sp. PBC"
## [1048] "s__microcystinivorans"
## [1049] "s__sp. PGP41"
## [1050] "s__sp. DSM 15011"
## [1051] "s__sp. NBRC 113351"
## [1052] "s__timorensis"
## [1053] "s__ureae"
## [1054] "s__akajimensis"
## [1055] "s__cystitidis"
## [1056] "s__pacificus"
## [1057] "s__pseudonitzschiae"
## [1058] "s__sp. AMCC400023"
## [1059] "s__anaerobium"
## [1060] "s__solisilvae"
## [1061] "s__terrestris"
## [1062] "s__psychrophila"
## [1063] "s__solanacearum"
## [1064] "s__sp. HDW16"
## [1065] "s__sp. (ex Biomphalaria glabrata)"
## [1066] "s__ihumii"
## [1067] "s__guodeyinii"
## [1068] "s__sp. L9-4"
## [1069] "s__sp. YRD-M1"
## [1070] "s__marinisabuli"
## [1071] "s__moniliformis"
## [1072] "s__oleronia"
## [1073] "s__aquatica"
## [1074] "s__griseochromogenes"
## [1075] "s__sp. BH-2-1-1"
## [1076] "s__urinae"
## [1077] "s__xanthus"
## [1078] "s__aespoeensis"
## [1079] "s__formicigenerans"
## [1080] "s__faecalis"
## [1081] "s__saurashtrense"
## [1082] "s__sp. ESL0704"
## [1083] "s__vinelandii"
## [1084] "s__sp. USK10"
## [1085] "s__dongpingensis"
## [1086] "s__glaciei"
```

```
## [1087] "s__sambongensis"
## [1088] "s__sp. G11"
## [1089] "s__catena"
## [1090] "s__fodineus"
## [1091] "s__mannosilyticum"
## [1092] "s__junii"
## [1093] "s__weilii"
## [1094] "s__canadensis"
## [1095] "s__rugosus"
## [1096] "s__sp. KBS0714"
## [1097] "s__hortorum"
## [1098] "s__cerasi"
## [1099] "s__fastidiosa"
## [1100] "s__australiensis"
## [1101] "s__paradoxus"
## [1102] "s__yeei"
## [1103] "s__etheniformans"
## [1104] "s__luteolum"
## [1105] "s__aureofaciens"
## [1106] "s__gregorii"
## [1107] "s__sp. DNA4"
## [1108] "s__chlorophenolicus"
## [1109] "s__sp. LGH"
## [1110] "s__sp. 2017"
## [1111] "s__agalactiae"
## [1112] "s__canis"
## [1113] "s__nodulans"
## [1114] "s__aureum"
## [1115] "s__toyohensis"
## [1116] "s__gephyra"
## [1117] "s__aminofermentans"
## [1118] "s__genomosp. 13"
## [1119] "s__sp. Dgby_cultured_2"
## [1120] "s__arsenicus"
## [1121] "s__marisgermanici"
## [1122] "s__lari"
## [1123] "s__stantonii"
## [1124] "s__megaguti"
## [1125] "s__graminis"
## [1126] "s__cellulosilyticus"
## [1127] "s__sp. zg-Y815"
## [1128] "s__sp. I2-3-92"
## [1129] "s__sacchari"
## [1130] "s__nassauensis"
## [1131] "s__sp. ES.047"
## [1132] "s__brasiliensis"
## [1133] "s__colihominis"
## [1134] "s__maltosivorans"
## [1135] "s__sp. SO9"
## [1136] "s__malefermentans"
## [1137] "s__wangleii"
## [1138] "s__sp. SL43"
## [1139] "s__sp. SGAir0207"
## [1140] "s__potens"
```

```
## [1141] "s__tritici"
## [1142] "s__jejuensis"
## [1143] "s__sp. CBW1006"
## [1144] "s__taeniosporum"
## [1145] "s__glucosotrophus"
## [1146] "s__sp. ABG19"
## [1147] "s__sp. HM134"
## [1148] "s__rhizovicinus"
## [1149] "s__cadaveris"
## [1150] "s__navarrensis"
## [1151] "s__peucetius"
## [1152] "s__sp. zg-629"
## [1153] "s__mucilyticum"
## [1154] "s__triazinivorans"
## [1155] "s__pleomorphus"
## [1156] "s__termitida"
## [1157] "s__vulgatus"
## [1158] "s__sp. wino2"
## [1159] "s__frisingense"
## [1160] "s__paralvei"
## [1161] "s__sp. CD1"
## [1162] "s__periodonticum"
## [1163] "s__inopinata"
## [1164] "s__chartreusis"
## [1165] "s__uberis"
## [1166] "s__parauberis"
## [1167] "s__sp. R5-89-07"
## [1168] "s__antarcticus"
## [1169] "s__sp. S3-43"
## [1170] "s__acticola"
## [1171] "s__sp. WMMD937"
## [1172] "s__cynanchi"
## [1173] "s__dendritiformis"
## [1174] "s__saprophyticus"
## [1175] "s__sp. LH3U1"
## [1176] "s__choerinum"
## [1177] "s__parasitica"
## [1178] "s__sp. 7M"
## [1179] "s__sp. KGMB00164"
## [1180] "s__bronchialis"
## [1181] "s__elenkinii"
## [1182] "s__sp. N4-1P"
## [1183] "s__syzygii"
## [1184] "s__smegmatis"
## [1185] "s__eligens"
## [1186] "s__goriensis"
## [1187] "s__kitaharae"
## [1188] "s__phototrophica"
## [1189] "s__communis"
## [1190] "s__grayi"
## [1191] "s__sp. TJ11"
## [1192] "s__noguchii"
## [1193] "s__luteifluviistationis"
## [1194] "s__foliorum"
```

```
## [1195] "s__sp. UKPF54-2"
## [1196] "s__madurae"
## [1197] "s__sp. A15-44"
## [1198] "s__halotolerans"
## [1199] "s__hydrocarbonoxydans"
## [1200] "s__jilunlii"
## [1201] "s__magneticus"
## [1202] "s__jeddahense"
## [1203] "s__palustris"
## [1204] "s__corporis"
## [1205] "s__genosp. B"
## [1206] "s__heidelbergense"
## [1207] "s__madagascariense"
## [1208] "s__pneumoniae"
## [1209] "s__sp. TF02-10"
## [1210] "s__yangpuensis"
## [1211] "s__sp. BJN0001"
## [1212] "s__toluolica"
## [1213] "s__atrophaeus"
## [1214] "s__sp. IP-1-18"
## [1215] "s__sp. B183"
## [1216] "s__sp. CO-6"
## [1217] "s__sp. ATCC 39006"
## [1218] "s__sp. SORT26"
## [1219] "s__sp. MORI2"
## [1220] "s__sp. GU-1"
## [1221] "s__proteolyticus"
## [1222] "s__weissii"
## [1223] "s__vulgare"
## [1224] "s__verrucosa"
## [1225] "s__oryzihabitans"
## [1226] "s__sp. SSW1-51"
## [1227] "s__oligotrophus"
## [1228] "s__dongxiuzhuiae"
## [1229] "s__sp. MMS21-STM10"
## [1230] "s__sp. DG25A"
## [1231] "s__urinalis"
## [1232] "s__duncaniae"
## [1233] "s__pseudomesenteroides"
## [1234] "s__sp. I3-3-33"
## [1235] "s__sp. PCC 7367"
## [1236] "s__necrophorum"
## [1237] "s__cellulovorans"
## [1238] "s__endosymbiont of unidentified scaly snail isolate Monju"
## [1239] "s__backii"
## [1240] "s__woodii"
## [1241] "s__roseum"
## [1242] "s__sp. K90mix"
## [1243] "s__litoralis"
## [1244] "s__sp. 905_Psudmo1"
## [1245] "s__merdae"
## [1246] "s__virosa"
## [1247] "s__sp. 4G125"
## [1248] "s__gibsoniae"
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## [1249] "s__sp. DMF-1"
## [1250] "s__pacifica"
## [1251] "s__plantisponsor"
## [1252] "s__monocytogenes"
## [1253] "s__mucimassa"
## [1254] "s__hibernicus"
## [1255] "s__neteri"
## [1256] "s__phragmitetus"
## [1257] "s__sp. ESL0775"
## [1258] "s__hypogea"
## [1259] "s__falsenii"
## [1260] "s__limosum"
## [1261] "s__metallidurans"
## [1262] "s__eucalypticola"
## [1263] "s__gonidiaformans"
## [1264] "s__[Clostridium] innocuum"
## [1265] "s__sp. 432"
## [1266] "s__sp. 20-132"
## [1267] "s__sp. JZ18"
## [1268] "s__sp. SS-MA-C1-2"
## [1269] "s__sp. RM12651"
## [1270] "s__kanamyceticus"
## [1271] "s__sp. A10-1-5-1"
## [1272] "s__acidocaldarius"
## [1273] "s__sp. AOP6"
## [1274] "s__sp. 2447"
## [1275] "s__sp. AMBV1719"
## [1276] "s__luticellarii"
## [1277] "s__flavithermus"
## [1278] "s__pseudomallei"
## [1279] "s__fonticola"
## [1280] "s__sp. SMC-8"
## [1281] "s__haemolyticum"
## [1282] "s__carnosum"
## [1283] "s__purpureochromogenes"
## [1284] "s__sp. RerS4"
## [1285] "s__shinshuensis"
## [1286] "s__sp. YC1"
## [1287] "s__sp. G2-70"
## [1288] "s__fulva"
## [1289] "s__suaedae"
## [1290] "s__sp. XHJ-5"
## [1291] "s__pretoriensis"
## [1292] "s__mucicolens"
## [1293] "s__physcomitrellae"
## [1294] "s__capitis"
## [1295] "s__qitaiheensis"
## [1296] "s__syringae"
## [1297] "s__aerogenes"
## [1298] "s__praevalens"
## [1299] "s__zymae"
## [1300] "s__subrutilus"
## [1301] "s__sp. NIES-970"
## [1302] "s__sp. I4-1-79"
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## [1303] "s__plantarum"
## [1304] "s__fragilis"
## [1305] "s__ureilytica"
## [1306] "s__sp. LA31"
## [1307] "s__equolifaciens"
## [1308] "s__salexigens"
## [1309] "s__huguangmaarense"
## [1310] "s__benzoatilyticus"
## [1311] "s__sp. SirexAA-E"
## [1312] "s__butyricum"
## [1313] "s__furentiruminis"
## [1314] "s__breve"
## [1315] "s__sp. WMMD791"
## [1316] "s__pseudocatenulatum"
## [1317] "s__dechloratans"
## [1318] "s__sp. XT11"
## [1319] "s__gummiphilus"
## [1320] "s__lactis"
## [1321] "s__[Clostridium] hylemonae"
## [1322] "s__magnusonii"
## [1323] "s__yushuensis"
## [1324] "s__hirae"
## [1325] "s__acetoxidans"
## [1326] "s__xenovorans"
## [1327] "s__sp. SCSIO 76264"
## [1328] "s__sp. RHB36-C18"
## [1329] "s__albus"
## [1330] "s__endosymbiont of Euscepes postfasciatus"
## [1331] "s__purcellii"
## [1332] "s__sp. NBC_00550"
## [1333] "s__sp. TS-293"
## [1334] "s__soudanensis"
## [1335] "s__sp. FDAARGOS 1405"
## [1336] "s__endosymbiont of 'Nebria riversi'"
## [1337] "s__sp. M4R1S46"
## [1338] "s__sp. AP-Nino-20-G2"
## [1339] "s__asaccharolytica"
## [1340] "s__salinum"
## [1341] "s__sp. oral taxon 894"
## [1342] "s__sp. WMMB 499"
## [1343] "s__cholangitidis"
## [1344] "s__sp. HDW6C"
## [1345] "s__acidiphilus"
## [1346] "s__sp. Arc7-DN-1"
## [1347] "s__oremlandii"
## [1348] "s__sp. co_0103"
## [1349] "s__intermedius"
## [1350] "s__sp. RBIITD"
## [1351] "s__suwonensis"
## [1352] "s__sp. SFB-mouse"
## [1353] "s__carbinolicus"
## [1354] "s__sp. VKM Ac-2805"
## [1355] "s__agaridevorans"
## [1356] "s__barcinonensis"
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## [1357] "s__sp. CP1"
## [1358] "s__sp. AJ005"
## [1359] "s__goeteborgense"
## [1360] "s__sp. SMBL_HHYL_HB1"
## [1361] "s__sp. Nx66"
## [1362] "s__anserum"
## [1363] "s__spinosum"
## [1364] "s__pollutisoli"
## [1365] "s__acidophilus"
## [1366] "s__sabinae"
## [1367] "s__cardium"
## [1368] "s__onobrychidis"
## [1369] "s__citreum"
## [1370] "s__wulumuqiensis"
## [1371] "s__chlororaphis"
## [1372] "s__ultunensis"
## [1373] "s__nematophila"
## [1374] "s__linens"
## [1375] "s__gilardii"
## [1376] "s__toyonensis"
## [1377] "s__sp. CACC 737"
## [1378] "s__segmentosum"
## [1379] "s__sp. FW306-2-2C-D06B"
## [1380] "s__gladioli"
## [1381] "s__sp. JB2"
## [1382] "s__acidilactici"
## [1383] "s__turnerae"
## [1384] "s__carrageenivorans"
## [1385] "s__amiense"
## [1386] "s__paracasei"
## [1387] "s__sp. NBEC-018"
## [1388] "s__xylanivorans"
## [1389] "s__cecorum"
## [1390] "s__sp. Marseille-Q6967"
## [1391] "s__christensenii"
## [1392] "s__anatis"
## [1393] "s__kristinae"
## [1394] "s__sp. oral taxon 171"
## [1395] "s__fermentum"
## [1396] "s__glycerini"
## [1397] "s__sp. SC05B48"
## [1398] "s__sp. FW80"
## [1399] "s__dendranthematis"
## [1400] "s__calidilacus"
## [1401] "s__sp. QA3"
## [1402] "s__convoluta"
## [1403] "s__sp. Clip185"
## [1404] "s__aphidicola"
## [1405] "s__pluranimalium"
## [1406] "s__sp. H8"
## [1407] "s__kalamazoonensis"
## [1408] "s__sp. YIM 151500-1"
## [1409] "s__bangladeshense"
## [1410] "s__sp. HN38"
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## [1411] "s__ruminis"
## [1412] "s__sp. HL-2"
## [1413] "s__campestris"
## [1414] "s__clavuligerus"
## [1415] "s__forsythia"
## [1416] "s__sp. SCSIO 43206"
## [1417] "s__ihbetae"
## [1418] "s__aurimucosum"
## [1419] "s__populi"
## [1420] "s__mannitolilytica"
## [1421] "s__sp. GilTou73"
## [1422] "s__sulfoxidireducens"
## [1423] "s__sp. FSL H7-0357"
## [1424] "s__eulemuris"
## [1425] "s__timonae"
## [1426] "s__pickeringii"
## [1427] "s__aerolata"
## [1428] "s__alcaliphilus"
## [1429] "s__boronicumulans"
## [1430] "s__mikurensis"
## [1431] "s__sp. AR02"
## [1432] "s__sp. RAC01"
## [1433] "s__balustinum"
## [1434] "s__metallireducens"
## [1435] "s__lycopersici"
## [1436] "s__tendae"
## [1437] "s__agnetis"
## [1438] "s__ovata"
## [1439] "s__marianensis"
## [1440] "s__catus"
## [1441] "s__rubrifaciens"
## [1442] "s__sp. oral taxon 190"
## [1443] "s__aerotolerans"
## [1444] "s__rossiae"
## [1445] "s__sp. SL75"
## [1446] "s__plasticadhaerens"
## [1447] "s__iranicus"
## [1448] "s__xylanolytica"
## [1449] "s__aromaticivorans"
## [1450] "s__morbillorum"
## [1451] "s__gilvum"
## [1452] "s__cellulositrophicus"
## [1453] "s__longum"
## [1454] "s__showae"
## [1455] "s__sp. T1-3-2"
## [1456] "s__sp. DEMB1"
## [1457] "s__subvibrioides"
## [1458] "s__sp. zth1"
## [1459] "s__durans"
## [1460] "s__occultum"
## [1461] "s__sediminicola"
## [1462] "s__anguillarum"
## [1463] "s__cyclohexanicum"
## [1464] "s__diminuta"
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## [1465] "s__thermoamylovorans"
## [1466] "s__sp. COW1"
## [1467] "s__sp. X23"
## [1468] "s__sp. 'Marine'"
## [1469] "s__sp. PAMC22086"
## [1470] "s__nitratireducens"
## [1471] "s__marcescens"
## [1472] "s__sp. SYSU D00693"
## [1473] "s__rhizosphaerae"
## [1474] "s__sp. KCTC 72723"
## [1475] "s__Paradesulfovibrio bizertensis"
## [1476] "s__sp. SCSIO 80058"
## [1477] "s__winogradskyi"
## [1478] "s__woesei"
## [1479] "s__fontis"
## [1480] "s__sp. Marseille-Q7238"
## [1481] "s__ochotonae"
## [1482] "s__mytili"
## [1483] "s__phthalatica"
## [1484] "s__sp. OF-1"
## [1485] "s__sp. GSB1"
## [1486] "s__pilosicoli"
## [1487] "s__sp. G128"
## [1488] "s__campbellii"
## [1489] "s__keratini"
## [1490] "s__sp. B6464"
## [1491] "s__pylori"
## [1492] "s__sp. X19"
## [1493] "s__fluvialis"
## [1494] "s__pennivorans"
## [1495] "s__caecimuris"
## [1496] "s__albidoflavus"
## [1497] "s__turbinis"
## [1498] "s__schindleri"
## [1499] "s__algae"
## [1500] "s__sp. 86"
## [1501] "s__mccartyi"
## [1502] "s__sciuri"
## [1503] "s__prausnitzii"
## [1504] "s__edaphicus"
## [1505] "s__succinatutens"
## [1506] "s__hormaechei"
## [1507] "s__versatilis"
## [1508] "s__maltaromaticum"
## [1509] "s__sp. X9"
## [1510] "s__reuteri"
## [1511] "s__cernigliae"
## [1512] "s__sp. A1C1"
## [1513] "s__tumefaciens"
## [1514] "s__boydii"
## [1515] "s__sp. B3.7"
## [1516] "s__detoxificans"
## [1517] "s__sp. HSL-3221"
## [1518] "s__busanensis"
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## [1519] "s__caenitepidi"
## [1520] "s__wadsworthensis"
## [1521] "s__intermedia"
## [1522] "s__vaviloviae"
## [1523] "s__sp. CB2312"
## [1524] "s__alcalifaciens"
## [1525] "s__defragrans"
## [1526] "s__velezensis"
## [1527] "s__currus"
## [1528] "s__sp. ESL0764"
## [1529] "s__stellifer"
## [1530] "s__mali"
## [1531] "s__sp. LPB0319"
## [1532] "s__yonginensis"
## [1533] "s__equigenitalis"
## [1534] "s__sp. TLY01"
## [1535] "s__sp. L3-i22"
## [1536] "s__molluscorum"
## [1537] "s__sp. NS3"
## [1538] "s__urolithinfaciens"
## [1539] "s__colletis"
## [1540] "s__massiliense"
## [1541] "s__diphtheriae"
## [1542] "s__suis"
## [1543] "s__morelensis"
## [1544] "s__comscasis"
## [1545] "s__aurantia"
## [1546] "s__sp. DAIF2"
## [1547] "s__thermocatenulatus"
## [1548] "s__profundus"
## [1549] "s__elegans"
## [1550] "s__humidisoli"
## [1551] "s__sp. M62/1"
## [1552] "s__carbonacea"
## [1553] "s__socranskii"
## [1554] "s__sp. 1(2017)"
## [1555] "s__sp. A1-2"
## [1556] "s__spadix"
## [1557] "s__sp. QA11"
## [1558] "s__sp. FERM BP-3421"
## [1559] "s__baumannii"
## [1560] "s__sp. WMMD1076"
## [1561] "s__[Ruminococcus] gnavus"
## [1562] "s__tianjinensis"
## [1563] "s__freudenreichii"
## [1564] "s__vitulinus"
## [1565] "s__lactatifermentans"
## [1566] "s__sp. PAMC 28766"
## [1567] "s__zhangwenhongii"
## [1568] "s__sp. SL55"
## [1569] "s__sp. DY30"
## [1570] "s__sp. S13-6-22"
## [1571] "s__helcogenes"
## [1572] "s__sp. SGAir0253"
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## [1573] "s__fluorescens"
## [1574] "s__poriferae"
## [1575] "s__profunda"
## [1576] "s__lienomycini"
## [1577] "s__fuscus"
## [1578] "s__umeaense"
## [1579] "s__sp. B21-035"
## [1580] "s__rubrisubalbicans"
## [1581] "s__tabanidicola"
## [1582] "s__herbifermentans"
## [1583] "s__pratensis"
## [1584] "s__marinum"
## [1585] "s__anomalus"
## [1586] "s__hejianensis"
## [1587] "s__sp. OMZ 857"
## [1588] "s__dorei"
## [1589] "s__heilongjiangensis"
## [1590] "s__badius"
## [1591] "s__sp. L3A6"
## [1592] "s__sp. KUDC1714"
## [1593] "s__sp. Marseille-Q4132"
## [1594] "s__sp. TSH100"
## [1595] "s__sp. P02-A3a"
## [1596] "s__sulfodismutans"
## [1597] "s__anginosus"
## [1598] "s__acidifaciens"
## [1599] "s__sp. ZJ932"
## [1600] "s__hydrogenoformans"
## [1601] "s__sulfurreducens"
## [1602] "s__cohnii"
## [1603] "s__alimapuensis"
## [1604] "s__sp. T808"
## [1605] "s__sp. SCSIO 43195"
## [1606] "s__volantium"
## [1607] "s__sp. C56-T3"
## [1608] "s__sp. E9-3"
## [1609] "s__gasigenes"
## [1610] "s__sp. P6-10-X1"
## [1611] "s__fumaroxidans"
## [1612] "s__sp. CA-258035"
## [1613] "s__yanoikuyae"
## [1614] "s__houyundeii"
## [1615] "s__gallaeciensis"
## [1616] "s__iranensis"
## [1617] "s__raichei"
## [1618] "s__uliginis"
## [1619] "s__limnophila"
## [1620] "s__roggenkampii"
## [1621] "s__ferrugineus"
## [1622] "s__sp. SYP-B4298"
## [1623] "s__gergoviae"
## [1624] "s__sp. Kera G14"
## [1625] "s__nepalensis"
## [1626] "s__sp. WY2"
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## [1627] "s__sulfidiphilus"
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## [1629] "s__tusciae"
## [1630] "s__wadei"
## [1631] "s__aponinum"
## [1632] "s__paracollinoides"
## [1633] "s__cylindroides"
## [1634] "s__flavigena"
## [1635] "s__terricola"
## [1636] "s__salyersiae"
## [1637] "s__caviae"
## [1638] "s__sp. NHF165"
## [1639] "s__tyrobutyricum"
## [1640] "s__butyrica"
## [1641] "s__paralicheniformis"
## [1642] "s__wangjianweii"
## [1643] "s__naphthalenivorans"
## [1644] "s__Candidatus Promineofilum breve"
## [1645] "s__cycloheptanicus"
## [1646] "s__inhibens"
## [1647] "s__flavescens"
## [1648] "s__acidaminophilum"
## [1649] "s__coprosuis"
## [1650] "s__haloalkaliphila"
## [1651] "s__sp. ESL0680"
## [1652] "s__foraminis"
## [1653] "s__sp. S3"
## [1654] "s__globosa"
## [1655] "s__crustorum"
## [1656] "s__yellowstonii"
## [1657] "s__xerosis"
## [1658] "s__buchneri"
## [1659] "s__albicereus"
## [1660] "s__sp. C1"
## [1661] "s__radiodurans"
## [1662] "s__sp. B11"
## [1663] "s__sp. SMC90"
## [1664] "s__dysenteriae"
## [1665] "s__primitia"
## [1666] "s__sp. PROV188"
## [1667] "s__sp. XES5"
## [1668] "s__sp. Kuro-4"
## [1669] "s__perfilievii"
## [1670] "s__estertheticum"
## [1671] "s__longicatena"
## [1672] "s__autotrophicus"
## [1673] "s__sp. AB-CW3"
## [1674] "s__cattleyae"
## [1675] "s__innesii"
## [1676] "s__sp. ERMR1:05"
## [1677] "s__chipingensis"
## [1678] "s__beringensis"
## [1679] "s__uniformis"
## [1680] "s__obeum"
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## [1681] "s__agglomerans"
## [1682] "s__macerans"
## [1683] "s__sp. GQFP"
## [1684] "s__sp. CA-230715"
## [1685] "s__sp. YMD61"
## [1686] "s__desulfuricans"
## [1687] "s__vagans"
## [1688] "s__comes"
## [1689] "s__pseudococcoides"
## [1690] "s__quintana"
## [1691] "s__allii"
## [1692] "s__aerophila"
## [1693] "s__zucineum"
## [1694] "s__marmotae"
## [1695] "s__parahaemolyticus"
## [1696] "s__jejuni"
## [1697] "s__maltophilia"
## [1698] "s__granulosum"
## [1699] "s__sp. MC1750"
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## [1701] "s__alexandrii"
## [1702] "s__ramosa"
## [1703] "s__chelonae"
## [1704] "s__goldsteinii"
## [1705] "s__sp. s12"
## [1706] "s__humanifaecis"
## [1707] "s__casei"
## [1708] "s__sp. WUR7"
## [1709] "s__mycoides"
## [1710] "s__sp. SS"
## [1711] "s__insubricum"
## [1712] "s__citreus"
## [1713] "s__luporum"
## [1714] "s__sp. 2003-09-23"
## [1715] "s__sp. MSP4-1"
## [1716] "s__fibrisolvens"
## [1717] "s__sp. CBA3605"
## [1718] "s__culicicola"
## [1719] "s__sanfranciscensis"
## [1720] "s__sp. FSL R7-0273"
## [1721] "s__sp. JXN-3"
## [1722] "s__widdelii"
## [1723] "s__sp. CAA11"
## [1724] "s__sp. SGAir0471"
## [1725] "s__durmitorensis"
## [1726] "s__sp. PM5"
## [1727] "s__sp. IVB6181"
## [1728] "s__basilensis"
## [1729] "s__trematum"
## [1730] "s__methanica"
## [1731] "s__sp. ES-001"
## [1732] "s__sp. Ejp617"
## [1733] "s__hindlerae"
## [1734] "s__sp. PLM2"
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## [1735] "s__distasonis"
## [1736] "s__ivorii"
## [1737] "s__sp. NE5"
## [1738] "s__sp. X514"
## [1739] "s__sp. BRD128"
## [1740] "s__grimontii"
## [1741] "s__pauculus"
## [1742] "s__sp. L3A3"
## [1743] "s__sp. ZJ-18"
## [1744] "s__pusense"
## [1745] "s__imperatoris"
## [1746] "s__piscifermentans"
## [1747] "s__sp. AK164"
## [1748] "s__Verrucosispora sp. WMMC514"
## [1749] "s__jandaei"
## [1750] "s__halobius"
## [1751] "s__chromatireducens"
## [1752] "s__hungatei"
## [1753] "s__sp. oral taxon 368"
## [1754] "s__sp. IP-3-29"
## [1755] "s__sp. ACO-34A"
## [1756] "s__glomerans"
## [1757] "s__sp. WQ 127309"
## [1758] "s__parvula"
## [1759] "s__thermosaccharolyticum"
## [1760] "s__donghaensis"
## [1761] "s__hydrolyticum"
## [1762] "s__arlettae"
## [1763] "s__molinativorax"
## [1764] "s__naeslundii"
## [1765] "s__sp. YPW6"
## [1766] "s__sp. NIBR 02145"
## [1767] "s__seriolae"
## [1768] "s__clostridioformis"
## [1769] "s__sp. QWL-01"
## [1770] "s__wutianyii"
## [1771] "s__volcania"
## [1772] "s__stenotrophicus"
## [1773] "s__turicensis"
## [1774] "s__matruchotii"
## [1775] "s__curtisii"
## [1776] "s__simiae"
## [1777] "s__dhakensis"
## [1778] "s__paraplantarum"
## [1779] "s__epidermidis"
## [1780] "s__aptenodytis"
## [1781] "s__sp. PAMC25564"
## [1782] "s__liquefaciens"
## [1783] "s__polyisoprenivorans"
## [1784] "s__crudilactis"
## [1785] "s__caldarium"
## [1786] "s__piger"
## [1787] "s__pondensis"
## [1788] "s__asburiae"
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## [1789] "s__sp. SCSIO 43702"
## [1790] "s__sp. KD337-16"
## [1791] "s__symbiotica"
## [1792] "s__sp. VF16"
## [1793] "s__myrionectae"
## [1794] "s__sp. PAMC22021"
## [1795] "s__flava (ex Peng et al. 2021)"
## [1796] "s__cellulosum"
## [1797] "s__sp. YIM 151858-1"
## [1798] "s__sp. ZJ1417"
## [1799] "s__mucidolens"
## [1800] "s__dieselolei"
## [1801] "s__woodyi"
## [1802] "s__petrolei"
## [1803] "s__archaeovorus"
## [1804] "s__neoaurum"
## [1805] "s__alocis"
## [1806] "s__narathiwatensis"
## [1807] "s__sp. HY1793"
## [1808] "s__marisflavi"
## [1809] "s__putidum"
## [1810] "s__sp. c-25"
## [1811] "s__saccharolytica"
## [1812] "s__tataouinensis"
## [1813] "s__koreense"
## [1814] "s__subtile"
## [1815] "s__psychroresistens"
## [1816] "s__thermotolerans"
## [1817] "s__daecheongense"
## [1818] "s__magneticum"
## [1819] "s__lacrimiformis"
## [1820] "s__beimenensis"
## [1821] "s__canettii"
## [1822] "s__porcorum"
## [1823] "s__cepacia"
## [1824] "s__echinofusca"
## [1825] "s__soli (ex Cha et al. 2016)"
## [1826] "s__acidipropionici"
## [1827] "s__sonnei"
## [1828] "s__sp. 1NLA3E"
## [1829] "s__dentalis"
## [1830] "s__pseudomycoides"
## [1831] "s__sagamiharensis"
## [1832] "s__farciminis"
## [1833] "s__molare"
## [1834] "s__sp. BRD67"
## [1835] "s__sakazakii"
## [1836] "s__macedonicus"
## [1837] "s__denticolens"
## [1838] "s__seriolicida"
## [1839] "s__orale"
## [1840] "s__ishizawai"
## [1841] "s__numidicum"
## [1842] "s__spanius"
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## [1843] "s__sp. BTAi1"
## [1844] "s__excentricus"
## [1845] "s__humosa"
## [1846] "s__sp. R2A3"
## [1847] "s__magnum"
## [1848] "s__enzymogenes"
## [1849] "s__histicola"
## [1850] "s__bicirculans"
## [1851] "s__vitaeruminis"
## [1852] "s__[Clostridium] scindens"
## [1853] "s__howellii"
## [1854] "s__sp. oral taxon 416"
## [1855] "s__sp. 693-2"
## [1856] "s__sp. KORDI-100"
## [1857] "s__euniceicola"
## [1858] "s__sp. YPG26"
## [1859] "s__ureilyticus"
## [1860] "s__xiamenensis"
## [1861] "s__sp. THAF38"
## [1862] "s__sp. BP5-C20A"
## [1863] "s__ochraceum"
## [1864] "s__sp. GRR-S6-38"
## [1865] "s__sp. BL0902"
## [1866] "s__fructivorans"
## [1867] "s__trichosporium"
## [1868] "s__pasteuri"
## [1869] "s__trachydisci"
## [1870] "s__sp. At-9b"
## [1871] "s__sarraceniae"
## [1872] "s__mageritense"
## [1873] "s__pullorum"
## [1874] "s__sp. AEP1-3"
## [1875] "s__sp. SR38"
## [1876] "s__succinatiphilus"
## [1877] "s__minuta"
## [1878] "s__durus"
## [1879] "s__fungorum"
## [1880] "s__ramosus"
## [1881] "s__herdmanii"
## [1882] "s__frumenti"
## [1883] "s__sp. A2-16"
## [1884] "s__elsdenii"
## [1885] "s__sp. P3"
## [1886] "s__oestradiolicum"
## [1887] "s__petrii"
## [1888] "s__sp. W0125-5"
## [1889] "s__sp. THAF9"
## [1890] "s__indologenes"
## [1891] "s__sp. SALV-R1"
## [1892] "s__sp. KNU-23"
## [1893] "s__sp. LIG4"
## [1894] "s__sp. MEBOG07"
## [1895] "s__clariflavus"
## [1896] "s__sp. oral taxon 299"
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## [1897] "s__sp. DN3"
## [1898] "s__kyphosi"
## [1899] "s__krabiensis"
## [1900] "s__sp. A29-2"
## [1901] "s__sp. FU40"
## [1902] "s__sp. NBH84"
## [1903] "s__spectabilis"
## [1904] "s__slackii"
## [1905] "s__sp. YJN-G"
## [1906] "s__dongkuii"
## [1907] "s__lacunae"
## [1908] "s__ginsengisoli An et al. 2013"
## [1909] "s__hengshuiensis"
## [1910] "s__tropicalis"
## [1911] "s__sp. YY7918"
## [1912] "s__vibrioides"
## [1913] "s__smaragdinae"
## [1914] "s__adolescentis"
## [1915] "s__translucens"
## [1916] "s__sp. Psy1"
## [1917] "s__balearica"
## [1918] "s__griseoviridis"
## [1919] "s__echinaurantiaca"
## [1920] "s__sp. C49"
## [1921] "s__sp. TNS106"
## [1922] "s__pamelaeae"
## [1923] "s__sp. BSL-9"
## [1924] "s__nanhaiensis"
## [1925] "s__sp. HL-111"
## [1926] "s__sp. B006"
## [1927] "s__rhododendri"
## [1928] "s__sp. 5420S-77"
## [1929] "s__genosp. L"
## [1930] "s__onnuriiensis"
## [1931] "s__hellenica"
## [1932] "s__salsibiostraticola"
## [1933] "s__sp. Chiba101"
## [1934] "s__citrulli"
## [1935] "s__argi"
## [1936] "s__bornimense"
## [1937] "s__sp. PCC 7502"
## [1938] "s__sp. RUD330"
## [1939] "s__respiraculi"
## [1940] "s__sp. B4"
## [1941] "s__rhizophila"
## [1942] "s__sp. SCUT-3"
## [1943] "s__associata"
## [1944] "s__alkaliphila"
## [1945] "s__cyclinae"
## [1946] "s__ostreae"
## [1947] "s__angulatum"
## [1948] "s__meridiei"
## [1949] "s__ureicelerivorans"
## [1950] "s__sp. W002"
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## [1951] "s__ligni"
## [1952] "s__sp. E03"
## [1953] "s__stomatepiae"
## [1954] "s__mesonae"
## [1955] "s__lanthieri"
## [1956] "s__bacilliformis"
## [1957] "s__sp. SES19"
## [1958] "s__zoogloeoides"
## [1959] "s__finegoldii"
## [1960] "s__sp. 135"
## [1961] "s__violaceus"
## [1962] "s__glutamicum"
## [1963] "s__saccincola"
## [1964] "s__glycolicus"
## [1965] "s__sp. EG6"
## [1966] "s__insecticola"
## [1967] "s__heparinus"
## [1968] "s__silvestris"
## [1969] "s__porcinus"
## [1970] "s__rapamycinicus"
## [1971] "s__sp. PAMC 29467"
## [1972] "s__wexlerae"
## [1973] "s__dispar"
## [1974] "s__sp. PCC 7376"
## [1975] "s__seriniphilus"
## [1976] "s__sp. Idaho Grape"
## [1977] "s__sp. NB 10"
## [1978] "s__asiaticus"
## [1979] "s__confluentis"
## [1980] "s__sp. PAMC 25486"
## [1981] "s__equi"
## [1982] "s__ventriosum"
## [1983] "s__plautii"
## [1984] "s__sp. M10"
## [1985] "s__welbionis"
## [1986] "s__ubonensis"
## [1987] "s__casuarinae"
## [1988] "s__marcusii"
## [1989] "s__opacus"
## [1990] "s__acidiphila"
## [1991] "s__sp. SRCM116780"
## [1992] "s__sp. CE17"
## [1993] "s__neuii"
## [1994] "s__sp. WMMD714"
## [1995] "s__sp. PAMC28757"
## [1996] "s__mixta"
## [1997] "s__gilvosporeus"
## [1998] "s__sp. ATCC 55076"
## [1999] "s__etli"
## [2000] "s__contaminans"
## [2001] "s__corrodens"
## [2002] "s__formatexigens"
## [2003] "s__anophelis"
## [2004] "s__sp. MD294"
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## [2005] "s__catenulatum"
## [2006] "s__infera"
## [2007] "s__diolis"
## [2008] "s__actiniarum"
## [2009] "s__sp. MB263"
## [2010] "s__stercorarium"
## [2011] "s__sp. B1-46"
## [2012] "s__acetylenica"
## [2013] "s__harbinense"
## [2014] "s__capsici"
## [2015] "s__nordii"
## [2016] "s__exfoliatus"
## [2017] "s__sp. KBS0722"
## [2018] "s__sp. Z16"
## [2019] "s__tianxiuensis"
## [2020] "s__sp. HDW10"
## [2021] "s__paramesenteroides"
## [2022] "s__sp. FSL H7-0737"
## [2023] "s__alpinus"
## [2024] "s__acnes"
## [2025] "s__beijerinckii"
## [2026] "s__sp. GCEP-101"
## [2027] "s__mediatlanticus"
## [2028] "s__pluripotens"
## [2029] "s__konkukensis"
## [2030] "s__sp. SL191"
## [2031] "s__mundtii"
## [2032] "s__pseudintermedius"
## [2033] "s__sp. SCSIO 75817"
## [2034] "s__sp. HUAS12"
## [2035] "s__braakii"
## [2036] "s__pacificum"
## [2037] "s__sp. CT-WN-B3"
## [2038] "s__sp. YS12"
## [2039] "s__parasuis"
## [2040] "s__centenum"
## [2041] "s__tolerans"
## [2042] "s__sp. OMZ 788"
## [2043] "s__sp. RG1"
## [2044] "s__ilealis"
## [2045] "s__sporogenes"
## [2046] "s__wenshanensis"
## [2047] "s__hydrothermale"
## [2048] "s__modesticaldum"
## [2049] "s__shinii"
## [2050] "s__sp. DG01"
## [2051] "s__yuhuli"
## [2052] "s__savannae"
## [2053] "s__sp. BH-3-3-3"
## [2054] "s__sp. ME-1"
## [2055] "s__hyacinthi"
## [2056] "s__bifidum"
## [2057] "s__tiedjei"
## [2058] "s__lemurum"
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## [2059] "s__phaeolivaceus"
## [2060] "s__sp. S-1144"
## [2061] "s__jogaejeotgali"
## [2062] "s__sp. BIM B-1768"
## [2063] "s__sp. TH136"
## [2064] "s__glycovorans"
## [2065] "s__pentosus"
## [2066] "s__aegosomatissinici"
## [2067] "s__kirschneri"
## [2068] "s__hypermegale"
## [2069] "s__cattleyicolor"
## [2070] "s__isosaccharinicus"
## [2071] "s__isatidis"
## [2072] "s__sp. DMT04"
## [2073] "s__sp. 32-5/1"
## [2074] "s__sp. BNL1100"
## [2075] "s__acidiceleris"
## [2076] "s__equinus"
## [2077] "s__chubuense"
## [2078] "s__saccharolyticus"
## [2079] "s__vulneris"
## [2080] "s__trachealis"
## [2081] "s__polymorpha"
## [2082] "s__licheniformis"
## [2083] "s__sp. PDNC004"
## [2084] "s__cremoris"
## [2085] "s__lithophora"
## [2086] "s__sp. NP310"
## [2087] "s__varians"
## [2088] "s__aeruginosa"
## [2089] "s__milleri"
## [2090] "s__sp. fl3"
## [2091] "s__alactolyticus"
## [2092] "s__sp. HMT-352"
## [2093] "s__galegae"
## [2094] "s__sp. EMB200-NS6"
## [2095] "s__coldseepsis"
## [2096] "s__sp. CoE-012-22"
## [2097] "s__hathewayi"
## [2098] "s__sp. PHL 2737"
## [2099] "s__sp. COWG"
## [2100] "s__sp. LKL04"
## [2101] "s__naphthae"
## [2102] "s__xianingshaonis"
## [2103] "s__coprocola"
## [2104] "s__alkalilenta"
## [2105] "s__ingrahamii"
## [2106] "s__heyeri"
## [2107] "s__mutanolyticus"
## [2108] "s__upsaliensis"
## [2109] "s__chitinolyticus"
## [2110] "s__amalyticus"
## [2111] "s__amylophilus"
## [2112] "s__acidominimus"
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## [2113] "s__sandarakinum"
## [2114] "s__sp. MCM B-1480"
## [2115] "s__sp. NIES-3974"
## [2116] "s__silvaticum"
## [2117] "s__fairfieldensis"
## [2118] "s__piscolens"
## [2119] "s__sp. ESL0690"
## [2120] "s__sp. 6-C"
## [2121] "s__sp. SSW1-36"
## [2122] "s__sp. PCH239"
## [2123] "s__lydicus"
## [2124] "s__chlorophenolicum"
## [2125] "s__septicus"
## [2126] "s__immobilis"
## [2127] "s__sp. 762G35"
## [2128] "s__dadantii"
## [2129] "s__sp. Marseille-Q4147"
## [2130] "s__davisii"
## [2131] "s__sp. oral taxon 478"
## [2132] "s__cristatus"
## [2133] "s__sp. OXWO6B1"
## [2134] "s__faviae"
## [2135] "s__hansenii"
## [2136] "s__versutus"
## [2137] "s__sp. 1.5R"
## [2138] "s__crocatus"
## [2139] "s__mobile"
## [2140] "s__ectoiniformans"
## [2141] "s__sp. JA-3-3Ab"
## [2142] "s__caccae"
## [2143] "s__gordoncarteri"
## [2144] "s__pelargi"
## [2145] "s__sp. PK3_47"
## [2146] "s__ambifaria"
## [2147] "s__spiroformis"
## [2148] "s__sp. UFO1"
## [2149] "s__humi"
## [2150] "s__flexneri"
## [2151] "s__sp. M190262"
## [2152] "s__mucilaginosa"
## [2153] "s__sp. JBR18"
## [2154] "s__mitsuokai"
## [2155] "s__choanae"
## [2156] "s__sp. SynAce01"
## [2157] "s__coralloides"
## [2158] "s__sp. WCF-2"
## [2159] "s__persica"
## [2160] "s__cenocepacia"
## [2161] "s__sp. A4B17"
## [2162] "s__mantenii"
## [2163] "s__oxytoca"
## [2164] "s__fistulariae"
## [2165] "s__hassiacum"
## [2166] "s__sp. Y-9"
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## [2167] "s__nova"
## [2168] "s__caecicola"
## [2169] "s__arachidis"
## [2170] "s__sp. MG"
## [2171] "s__lentus"
## [2172] "s__tagluense"
## [2173] "s__sp. ORNL1"
## [2174] "s__phocae"
## [2175] "s__sp. DBS9H8"
## [2176] "s__orientalis"
## [2177] "s__sp. BDGP8"
## [2178] "s__castenholzii"
## [2179] "s__pilosa"
## [2180] "s__sp. P1Y"
## [2181] "s__sp. PAMC28650"
## [2182] "s__sp. Aquia_216"
## [2183] "s__marincola"
## [2184] "s__torques-reginae"
## [2185] "s__sp. YMA4"
## [2186] "s__sakei"
## [2187] "s__sp. ALC3"
## [2188] "s__azureus"
## [2189] "s__sp. SOS3"
## [2190] "s__striatum"
## [2191] "s__cibaria"
## [2192] "s__cellulosilytica"
## [2193] "s__peraridilitoris"
## [2194] "s__yamanorum"
## [2195] "s__stationis"
## [2196] "s__sp. GAS368"
## [2197] "s__multivorans"
## [2198] "s__melissae"
## [2199] "s__pronyensis"
## [2200] "s__erythrophlei"
## [2201] "s__unidentified bacterial endosymbiont"
## [2202] "s__Halalkalibacterium halodurans"
## [2203] "s__litorisediminis"
## [2204] "s__sp. WX"
## [2205] "s__ljungdahlii"
## [2206] "s__aurulentum"
## [2207] "s__harveyi"
## [2208] "s__hafniense"
## [2209] "s__litoris"
## [2210] "s__sp. JN-1"
## [2211] "s__bescii"
## [2212] "s__raffinolactis"
## [2213] "s__sp. BG8"
## [2214] "s__doosanense"
## [2215] "s__gigas"
## [2216] "s__luteum"
## [2217] "s__mexicana"
## [2218] "s__violaceum"
## [2219] "s__pasteurianum"
## [2220] "s__sp. W3-18-1"
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## [2221] "s__sp. KC8"
## [2222] "s__curvatus"
## [2223] "s__sp. Kera 3"
## [2224] "s__sp. B21-047"
## [2225] "s__sp. EM10"
## [2226] "s__glyciniphilum"
## [2227] "s__cereus"
## [2228] "s__sp. 'caverna'"
## [2229] "s__sophorae"
## [2230] "s__kefirresidentii"
## [2231] "s__sp. Y8"
## [2232] "s__sp. MA-2"
## [2233] "s__sp. PB12/4term"
## [2234] "s__sp. R8"
## [2235] "s__altitudinis"
## [2236] "s__limnaea"
## [2237] "s__stagnalis"
## [2238] "s__sp. MSR2"
## [2239] "s__sp. IMCC34777"
## [2240] "s__bilis"
## [2241] "s__sp. WS12"
## [2242] "s__ehrlichii"
## [2243] "s__lactucae"
## [2244] "s__sp. WF146"
## [2245] "s__sunii"
## [2246] "s__tetani"
## [2247] "s__sp. cB07"
## [2248] "s__cellulolyticum"
## [2249] "s__africana"
## [2250] "s__sp. KKS102"
## [2251] "s__sp. Z12"
## [2252] "s__iocasae"
## [2253] "s__shigaense"
## [2254] "s__halodurans"
## [2255] "s__alkalisoli"
## [2256] "s__arilaitensis"
## [2257] "s__dispersa"
## [2258] "s__sp. HH130629-09"
## [2259] "s__sp. DL-VIII"
## [2260] "s__sp. ALC70"
## [2261] "s__sp. SCPEA002"
## [2262] "s__succinogenes"
## [2263] "s__jinghuaiqii"
## [2264] "s__sp. M259"
## [2265] "s__sp. MC1862"
## [2266] "s__guangdongensis"
## [2267] "s__neonatale"
## [2268] "s__sp. AJA228-03"
## [2269] "s__odontolytica"
## [2270] "s__canimorsus"
## [2271] "s__sp. JUb54"
## [2272] "s__peoriae"
## [2273] "s__salivibrio"
## [2274] "s__timonense"
```

```
## [2275] "s__jensenii"
## [2276] "s__sp. ESL0790"
## [2277] "s__thuringiensis"
## [2278] "s__[Ruminococcus] lactaris"
## [2279] "s__sp. 24E2"
## [2280] "s__graeca"
## [2281] "s__taurus"
## [2282] "s__polytropus"
## [2283] "s__craniellae"
## [2284] "s__galactanivorans"
## [2285] "s__phaeum"
## [2286] "s__restrictus"
## [2287] "s__sp. VKM Ac-2760"
## [2288] "s__campestrisoli"
## [2289] "s__exhalans"
## [2290] "s__enterica"
## [2291] "s__sp. NEAU-S7GS2"
## [2292] "s__sp. L2-79-05"
## [2293] "s__kroppenstedtii"
## [2294] "s__scardovii"
## [2295] "s__sp. LS1212"
## [2296] "s__geestiana"
## [2297] "s__ishigakiensis"
## [2298] "s__splanchnicus"
## [2299] "s__sp. S16"
## [2300] "s__sp. 11-B-312"
## [2301] "s__aurantiaca"
## [2302] "s__serpentiformis"
## [2303] "s__sp. MS455"
## [2304] "s__saccharophila"
## [2305] "s__globerulus"
## [2306] "s__sp. E4742"
## [2307] "s__bethesdensis"
## [2308] "s__sp. KNUC1210"
## [2309] "s__obscurus"
## [2310] "s__luti"
## [2311] "s__boletus"
## [2312] "s__kimchii"
## [2313] "s__sp. K1W22B-7"
## [2314] "s__veronii"
## [2315] "s__rhusiopathiae"
## [2316] "s__sp. PGU16"
## [2317] "s__cryptocerci"
## [2318] "s__psychromarinicola"
## [2319] "s__sp. L3-i23"
## [2320] "s__youngiae"
## [2321] "s__sp. IHBB 10380"
## [2322] "s__sp. Fw109-5"
## [2323] "s__producens"
## [2324] "s__sp. BJN0003"
## [2325] "s__multipartita"
## [2326] "s__erdmanii"
## [2327] "s__micra"
## [2328] "s__orientis"
```

```
## [2329] "s__inkyongensis"
## [2330] "s__xenophagum"
## [2331] "s__sp. ESL0682"
## [2332] "s__carotovorum"
## [2333] "s__sulfidivorans"
## [2334] "s__sp. WSM4906"
## [2335] "s__atrarenae"
## [2336] "s__mediterranei"
## [2337] "s__sp. R24"
## [2338] "s__vulturis"
## [2339] "s__drentensis"
## [2340] "s__hallii"
## [2341] "s__obscuriglobus"
## [2342] "s__sp. TRM1-10"
## [2343] "s__sp. LPB0260"
## [2344] "s__eburnea"
## [2345] "s__liangshanensis"
## [2346] "s__formicoaceticum"
## [2347] "s__russatus"
```

```
subsetMG %>% get_taxa_unique("Species") # 4706 different order in total, so 242 species are not found i
```

```
##    [1] "s__symbiodeficiens"
##    [2] "s__sp. LM6"
##    [3] "s__sp. 5116S-3"
##    [4] "s__sp. 32K"
##    [5] "s__endosymbiont of Acanthamoeba sp. UWC8"
##    [6] "s__sp. CJ74"
##    [7] "s__sp. CR-Ec1"
##    [8] "s__rosea"
##    [9] "s__malaysiensis"
##   [10] "s__leguminosarum"
##   [11] "s__larvae"
##   [12] "s__salina"
##   [13] "s__paramultivorum"
##   [14] "s__sp. TY1-4"
##   [15] "s__endophytica"
##   [16] "s__flavum"
##   [17] "s__genomosp. 3"
##   [18] "s__sp. RR6"
##   [19] "s__mengziensis"
##   [20] "s__"
##   [21] "s__sp. ATA002"
##   [22] "s__equigenitalium"
##   [23] "s__sp. NEAU-sy36"
##   [24] "s__sp. M2A.F.Ca.ET.046.03.2.1"
##   [25] "s__gei"
##   [26] "s__vestfoldensis"
##   [27] "s__septicum"
##   [28] "s__alkanexedens"
##   [29] "s__sp. D15"
##   [30] "s__emersonii"
##   [31] "s__sp. THAF1"
##   [32] "s__sp. LH3H17"
```

```
##   [33] "s__sp. oral taxon 414"
##   [34] "s__sp. ESL0677"
##   [35] "s__sphaeroides"
##   [36] "s__luteus"
##   [37] "s__gaetbulicola"
##   [38] "s__mirabilis"
##   [39] "s__prevotii"
##   [40] "s__sp. DMV24BSW_D"
##   [41] "s__commune"
##   [42] "s__testudinis"
##   [43] "s__macrosporus"
##   [44] "s__sp. SCLE84"
##   [45] "s__tepida"
##   [46] "s__salinestris"
##   [47] "s__sp. MC1595"
##   [48] "s__everestensis"
##   [49] "s__oryzae"
##   [50] "s__caldiproteolyticus"
##   [51] "s__sp. MTB7"
##   [52] "s__difficile"
##   [53] "s__dentium"
##   [54] "s__sp. E76"
##   [55] "s__gangjinensis"
##   [56] "s__sp. LQ44"
##   [57] "s__profundi"
##   [58] "s__australis"
##   [59] "s__avium"
##   [60] "s__[Mannheimia] succiniciproducens"
##   [61] "s__sp. KSB-10"
##   [62] "s__arboricola"
##   [63] "s__chokoriensis"
##   [64] "s__sp. PSBB023"
##   [65] "s__palleroniana"
##   [66] "s__abyssi"
##   [67] "s__qiguomingii"
##   [68] "s__tangfeifanii"
##   [69] "s__cyanobacteriorum"
##   [70] "s__sihwensis"
##   [71] "s__gloriosae"
##   [72] "s__intestini"
##   [73] "s__glaucescens"
##   [74] "s__sp. RSMS"
##   [75] "s__propionicum"
##   [76] "s__alhagiae"
##   [77] "s__aestuarii"
##   [78] "s__gelatinosa"
##   [79] "s__sp. DHT3"
##   [80] "s__indolicus"
##   [81] "s__sp. 14171R-50"
##   [82] "s__ruminicola"
##   [83] "s__sp. PSKL.D1"
##   [84] "s__haemaphysalidis"
##   [85] "s__sp. 19OD2882"
##   [86] "s__actinosclerus"
```

```
##  [87] "s__suis"
##  [88] "s__manihotivorum"
##  [89] "s__sp. VBCF_01 NA2"
##  [90] "s__deleyi"
##  [91] "s__sp. HN-54"
##  [92] "s__sp. OT10"
##  [93] "s__bestiarum"
##  [94] "s__ulcerans"
##  [95] "s__pogona"
##  [96] "s__sp. DTU12.3"
##  [97] "s__pseudopelargi"
##  [98] "s__sp. Csp1"
##  [99] "s__vannielii"
## [100] "s__lutetiensis"
## [101] "s__kobei"
## [102] "s__fermentans"
## [103] "s__sp. HMF3514"
## [104] "s__sp. CACIAM 19H1"
## [105] "s__ruber"
## [106] "s__rotai"
## [107] "s__akebiae"
## [108] "s__sp. CCBAU 05631"
## [109] "s__sp. WJP83"
## [110] "s__sp. Y-01"
## [111] "s__thermophilus"
## [112] "s__tsuruhatensis"
## [113] "s__porcitonsillarum"
## [114] "s__farcinica"
## [115] "s__robiniae"
## [116] "s__sp. PDNC005"
## [117] "s__sp. CB0101"
## [118] "s__acidurici"
## [119] "s__radiodurans"
## [120] "s__gryphiswaldense"
## [121] "s__lacunae"
## [122] "s__acetatoxydans"
## [123] "s__taklimakanense"
## [124] "s__flava"
## [125] "s__parvum"
## [126] "s__aurantiacus"
## [127] "s__sp. KBS50"
## [128] "s__indica"
## [129] "s__tepidum"
## [130] "s__salmonicida"
## [131] "s__sp. B53371"
## [132] "s__corsica"
## [133] "s__gilvus"
## [134] "s__psychrotolerans"
## [135] "s__sp. SL97"
## [136] "s__sanguinis"
## [137] "s__boonkerdii"
## [138] "s__endosymbiont 'TC1' of Trimyema compressum"
## [139] "s__harei"
## [140] "s__sp. Aquia_213"
```

```
## [141] "s__inhibens"
## [142] "s__seropedicae"
## [143] "s__sp. 1_2014MBL_MicDiv"
## [144] "s__regensburgei"
## [145] "s__ambofaciens"
## [146] "s__lytica"
## [147] "s__mobilis"
## [148] "s__cyanea"
## [149] "s__extorquens"
## [150] "s__aurantiacum"
## [151] "s__choladocola"
## [152] "s__torquis"
## [153] "s__dioxanivorans"
## [154] "s__sp. GK1"
## [155] "s__sp. FJAT-42376"
## [156] "s__sicerae"
## [157] "s__sp. cx-51"
## [158] "s__sp. InS609-2"
## [159] "s__marinum"
## [160] "s__seohaensis"
## [161] "s__polymyxa"
## [162] "s__sp. N"
## [163] "s__planticola"
## [164] "s__sp. EV170708-02-1"
## [165] "s__lutea"
## [166] "s__nitratireducens"
## [167] "s__heimbachae"
## [168] "s__halophilus"
## [169] "s__indicum"
## [170] "s__variabilis"
## [171] "s__saerimneri"
## [172] "s__griseocarneus"
## [173] "s__ultunensis"
## [174] "s__sp. YIM 121038"
## [175] "s__roseus"
## [176] "s__guangdongense"
## [177] "s__sp. SN-593"
## [178] "s__waltersii"
## [179] "s__microcysteis"
## [180] "s__plicata"
## [181] "s__sp. PL-2018"
## [182] "s__sp. S09G 359"
## [183] "s__succinifaciens"
## [184] "s__sunshinyii"
## [185] "s__naejangsanensis"
## [186] "s__weaveri"
## [187] "s__sp. SK17"
## [188] "s__reducens"
## [189] "s__insidiosa"
## [190] "s__sp. YPW16"
## [191] "s__curvus"
## [192] "s__thermophilum"
## [193] "s__Candidatus Arsenophonus lipoptenae"
## [194] "s__sp. GAS474"
```

```
## [195] "s__denitrificans"
## [196] "s__sp. H1-7"
## [197] "s__geothermalis"
## [198] "s__sp. W1SF4"
## [199] "s__sp. D3"
## [200] "s__aestuariivivens"
## [201] "s__caledonica"
## [202] "s__sp. 19GGS1-52"
## [203] "s__bonchosmolovskayae"
## [204] "s__koreensis"
## [205] "s__ianthinogenes"
## [206] "s__sp. Xi13"
## [207] "s__lacustris"
## [208] "s__agarilyticus"
## [209] "s__sp. R3"
## [210] "s__sp. IBH004"
## [211] "s__infantis"
## [212] "s__sp. TCL240-02"
## [213] "s__changnyeongensis"
## [214] "s__featherlites"
## [215] "s__terpenica"
## [216] "s__wadenswilerensis"
## [217] "s__thiooxidans"
## [218] "s__balearica"
## [219] "s__stuttgartiensis"
## [220] "s__ulvae"
## [221] "s__bovigenitalium"
## [222] "s__audaxviator"
## [223] "s__sp. AJA081-3"
## [224] "s__sp. YMD87"
## [225] "s__longhuiensis"
## [226] "s__inefficax"
## [227] "s__sp. MX-AZ03"
## [228] "s__mitochondrii"
## [229] "s__sp. 113-3-9"
## [230] "s__confusa"
## [231] "s__aalborgensis"
## [232] "s__sp. M92"
## [233] "s__thiooxydans"
## [234] "s__carolinensis"
## [235] "s__gilva"
## [236] "s__sp. TGL-Y2"
## [237] "s__sp. E35C"
## [238] "s__riegelii"
## [239] "s__sp. LMS6"
## [240] "s__hiranonis"
## [241] "s__sp. Z13"
## [242] "s__sp. JY-X169"
## [243] "s__syrphidicola"
## [244] "s__lujinxingii"
## [245] "s__adiacens"
## [246] "s__suranareeae"
## [247] "s__sp. Wa41.01b-1"
## [248] "s__frigoritolerans"
```

```
## [249] "s__sputigena"
## [250] "s__defluvii"
## [251] "s__nasimurium"
## [252] "s__sonchi"
## [253] "s__xinjiangensis"
## [254] "s__sp. zrk46"
## [255] "s__sp. StoSoilB20"
## [256] "s__sp. YS"
## [257] "s__sp. J2-11"
## [258] "s__viridifaciens"
## [259] "s__musculi"
## [260] "s__iowae"
## [261] "s__fungivorans"
## [262] "s__polymorphum"
## [263] "s__soli"
## [264] "s__vitis"
## [265] "s__hyicus"
## [266] "s__nodosus"
## [267] "s__freneyi"
## [268] "s__sedimenticola"
## [269] "s__delphinicola"
## [270] "s__haeundaensis"
## [271] "s__gobiensis"
## [272] "s__zundukense"
## [273] "s__bremense"
## [274] "s__stearothermophilus"
## [275] "s__sp. FHR47"
## [276] "s__sp. 5317J-9"
## [277] "s__sp. PAMC28688"
## [278] "s__sp. KH32C"
## [279] "s__aquaticus"
## [280] "s__rhamnosus"
## [281] "s__lacus"
## [282] "s__sp. IDR2000157661"
## [283] "s__terrae"
## [284] "s__coyleae"
## [285] "s__minervae"
## [286] "s__dokdonensis"
## [287] "s__pigmentatum"
## [288] "s__oceani"
## [289] "s__sp. A34"
## [290] "s__khirikhana"
## [291] "s__sp. YST-16"
## [292] "s__sp. SMBL-WEM22"
## [293] "s__polymorphus"
## [294] "s__clarkii"
## [295] "s__schleiferi"
## [296] "s__sp. 3B(2020)"
## [297] "s__finlayi"
## [298] "s__armeniacus"
## [299] "s__infernorum"
## [300] "s__pseudintermedia"
## [301] "s__chengjingii"
## [302] "s__otitidis"
```

```
## [303] "s__algicola"
## [304] "s__sp. 17Sr1-1"
## [305] "s__ponti"
## [306] "s__sp. MIT S9220"
## [307] "s__sp. C1"
## [308] "s__gambrini"
## [309] "s__sp. SH-PL14"
## [310] "s__calystegiae"
## [311] "s__liaowanqingii"
## [312] "s__amarae"
## [313] "s__gelatinosus"
## [314] "s__sp. HS-3"
## [315] "s__sinusarabici"
## [316] "s__sp. FJAT-22090"
## [317] "s__mesenteroides"
## [318] "s__paludis"
## [319] "s__intestinalis"
## [320] "s__intermedia"
## [321] "s__agilis"
## [322] "s__desulfuricans"
## [323] "s__sp. MH6"
## [324] "s__vietnamiensis"
## [325] "s__fluoranthenivorans"
## [326] "s__sp. H13-6"
## [327] "s__izadpanahii"
## [328] "s__sp. S1-8"
## [329] "s__pinatubonensis"
## [330] "s__marina"
## [331] "s__agri"
## [332] "s__lapagei"
## [333] "s__swuensis"
## [334] "s__cuenoti"
## [335] "s__negevensis"
## [336] "s__rigui"
## [337] "s__pyridinivorans"
## [338] "s__sp. SCSIO 61187"
## [339] "s__caldus"
## [340] "s__sulfonylureivorans"
## [341] "s__parakoreensis"
## [342] "s__parva"
## [343] "s__multivorans"
## [344] "s__tropicus"
## [345] "s__sp. KH3-4"
## [346] "s__crevioricanis"
## [347] "s__broussonetiae"
## [348] "s__sp. oral taxon 807"
## [349] "s__staleyi"
## [350] "s__alboniger"
## [351] "s__baltica"
## [352] "s__sp. FB-5"
## [353] "s__atsumiense"
## [354] "s__amnigena"
## [355] "s__sp. PLM1"
## [356] "s__mishrai"
```

```
## [357] "s__uli"
## [358] "s__palythoae"
## [359] "s__sp. ZAC14A_NAIMI4_1"
## [360] "s__viscericola"
## [361] "s__hongkongensis"
## [362] "s__branconii"
## [363] "s__sp. HUAS 5"
## [364] "s__manganoxidans"
## [365] "s__raozihei"
## [366] "s__longa"
## [367] "s__glycinifermentans"
## [368] "s__gasseri"
## [369] "s__sp. M317"
## [370] "s__doucetiae"
## [371] "s__sp. ZFBP2030"
## [372] "s__pachyrhizi"
## [373] "s__hadrus"
## [374] "s__pecorum"
## [375] "s__sp. SM18"
## [376] "s__sp. TC1"
## [377] "s__sp. NIBR1757"
## [378] "s__sp. Allo2"
## [379] "s__condimenti"
## [380] "s__mallensis"
## [381] "s__bonaserana"
## [382] "s__sp. WY228"
## [383] "s__ficus"
## [384] "s__sp. ASNIH4"
## [385] "s__sp. WAC 06738"
## [386] "s__thiocyanaticus"
## [387] "s__sp. SCSIO 43088"
## [388] "s__sp. SD9660Na"
## [389] "s__sp. SYP-B4668"
## [390] "s__sp. TS-1"
## [391] "s__radiophilus"
## [392] "s__sp. OMZ 787"
## [393] "s__dioscoreae"
## [394] "s__coli"
## [395] "s__budapestensis"
## [396] "s__oculi"
## [397] "s__natechei"
## [398] "s__sp. SDW2"
## [399] "s__sp. NIES-981"
## [400] "s__circulans"
## [401] "s__paranthracis"
## [402] "s__rifamycinica"
## [403] "s__phyllanthi"
## [404] "s__sp. 20G"
## [405] "s__sp. CAP-1"
## [406] "s__salmonis"
## [407] "s__sp. M344"
## [408] "s__thailandicus"
## [409] "s__sp. I507"
## [410] "s__dauci"
```

```
## [411] "s__sp. SAT1"
## [412] "s__sp. HW608"
## [413] "s__sp. ESL0695"
## [414] "s__shayeganii"
## [415] "s__sp. INBF002"
## [416] "s__rhizoryzae"
## [417] "s__sp. DA9"
## [418] "s__rhizomae"
## [419] "s__dokdonellae"
## [420] "s__pedis"
## [421] "s__cucullus"
## [422] "s__sp."
## [423] "s__dispar"
## [424] "s__punjabense"
## [425] "s__ginsenosidimutans"
## [426] "s__Candidatus Sodalis pierantonius"
## [427] "s__bronchialis"
## [428] "s__naphthalenivorans"
## [429] "s__denticola"
## [430] "s__pakistanensis"
## [431] "s__sp. ZJ405"
## [432] "s__nataicola"
## [433] "s__amylolyticus"
## [434] "s__dentocariosa"
## [435] "s__jejuni"
## [436] "s__timonensis"
## [437] "s__italicus"
## [438] "s__protophormiae"
## [439] "s__sp. ESL0732"
## [440] "s__hyosynoviae"
## [441] "s__spongiae"
## [442] "s__crassostreae"
## [443] "s__rubrum"
## [444] "s__pabuli"
## [445] "s__rustigianii"
## [446] "s__fischeri"
## [447] "s__sp. YJ01"
## [448] "s__coelicolor"
## [449] "s__jeotgali"
## [450] "s__africanus"
## [451] "s__sp. 12200R-103"
## [452] "s__melaninogenica"
## [453] "s__sp. MG-5-Ahmo-C2"
## [454] "s__sp. N902-109"
## [455] "s__sp. 2438"
## [456] "s__siamensis"
## [457] "s__fonticola"
## [458] "s__sp. YTS05"
## [459] "s__jinjuensis"
## [460] "s__sp. TSA2s"
## [461] "s__pyogenes"
## [462] "s__flavibacter"
## [463] "s__phytohabitans"
## [464] "s__sp. ORS 285"
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## [465] "s__zeae"
## [466] "s__sp. CB3481"
## [467] "s__faecale"
## [468] "s__Candidatus Desulfovibrio trichonymphae"
## [469] "s__immobilis"
## [470] "s__carboxidivorans"
## [471] "s__sp. BSN-002"
## [472] "s__sp. WMMD975"
## [473] "s__kansasii"
## [474] "s__atlanticum"
## [475] "s__troglodytae"
## [476] "s__profunda"
## [477] "s__butanolivorans"
## [478] "s__zhangzhiyongii"
## [479] "s__pyrrocinia"
## [480] "s__sp. Marseille-Q3772"
## [481] "s__sp. ES10-3-2-2"
## [482] "s__pseudolongum"
## [483] "s__filamentosa"
## [484] "s__aeruginosa"
## [485] "s__hinzii"
## [486] "s__parasuis"
## [487] "s__hydrossis"
## [488] "s__sp. HTF-F"
## [489] "s__sp. KUDC0406"
## [490] "s__acetylenivorans"
## [491] "s__sp. NKC19-16"
## [492] "s__eiseniae"
## [493] "s__sp. Marseille-Q4385"
## [494] "s__brevis"
## [495] "s__bryantii"
## [496] "s__erythropolis"
## [497] "s__testosteroni"
## [498] "s__sp. AP-Jannik-300A-C4"
## [499] "s__oligotrophicus"
## [500] "s__sedentarius"
## [501] "s__branderi"
## [502] "s__ruminantium"
## [503] "s__sp. S5"
## [504] "s__curvata"
## [505] "s__Candidatus Pantoea carbekii"
## [506] "s__autotrophica"
## [507] "s__atypica"
## [508] "s__sp. erpn"
## [509] "s__entomophila"
## [510] "s__leopoldii"
## [511] "s__sp. SCSIO 43204"
## [512] "s__parmentieri"
## [513] "s__sp. CA-103260"
## [514] "s__normanense"
## [515] "s__aliphaticivorans"
## [516] "s__sp. 891-h"
## [517] "s__butyriciproducens"
## [518] "s__ginsengisoli"
```

```
## [519] "s__salsilacus"
## [520] "s__albertii"
## [521] "s__huifangae"
## [522] "s__variabile"
## [523] "s__Schlegelella aquatica"
## [524] "s__urealyticum"
## [525] "s__sp. EMRT-2"
## [526] "s__divergens"
## [527] "s__sp. SY8519"
## [528] "s__sp. ART55/1"
## [529] "s__sp. FW306-05-C"
## [530] "s__sp. KY-GH-1"
## [531] "s__mucogenicum"
## [532] "s__aggregatum"
## [533] "s__sp. PBL-H3"
## [534] "s__inopinata"
## [535] "s__lutimineralis"
## [536] "s__sp. PROS-U-1"
## [537] "s__antioxidans"
## [538] "s__sp. FDAARGOS_506"
## [539] "s__sp. PAMC 26628"
## [540] "s__sp. TMPB413"
## [541] "s__palustris"
## [542] "s__cortegadensis"
## [543] "s__paragallinarum"
## [544] "s__colombiense"
## [545] "s__melonis"
## [546] "s__nishinomiyaensis"
## [547] "s__sp. AP4-R1"
## [548] "s__sp. SVR"
## [549] "s__anaerophila"
## [550] "s__sp. M54"
## [551] "s__luteola"
## [552] "s__solani"
## [553] "s__alaskensis"
## [554] "s__cryaerophilus"
## [555] "s__sp. HF10"
## [556] "s__maiorica"
## [557] "s__salarius"
## [558] "s__cedrina"
## [559] "s__sp. oral taxon 920"
## [560] "s__sp. NIBR 498073"
## [561] "s__panis"
## [562] "s__dicambivorans"
## [563] "s__sp. KU26590"
## [564] "s__sp. H2931"
## [565] "s__sp. HDW4A"
## [566] "s__chondrophila"
## [567] "s__armeniaca"
## [568] "s__mucosa"
## [569] "s__sp. resist"
## [570] "s__viridans"
## [571] "s__sp. StoSoilA2"
## [572] "s__moriokaense"
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## [573] "s__cicadellinicola"
## [574] "s__aestuariivivum"
## [575] "s__brennaborense"
## [576] "s__sp. fd1-xmd"
## [577] "s__sp. GL2"
## [578] "s__resinovorans"
## [579] "s__baldaniorum"
## [580] "s__caldoxylosilyticus"
## [581] "s__sp. oral taxon 126"
## [582] "s__chitae"
## [583] "s__sp. dk3624"
## [584] "s__halotolerans"
## [585] "s__sp. LMS-CY"
## [586] "s__litoralis"
## [587] "s__sp. CT06"
## [588] "s__sp. NEB1569"
## [589] "s__brunensis"
## [590] "s__jostii"
## [591] "s__sp. B21-053"
## [592] "s__sp. AS-1"
## [593] "s__alkaliphilum"
## [594] "s__yuyongxinii"
## [595] "s__sp. SCSIO W1101"
## [596] "s__sp. 17 mud 1-3"
## [597] "s__tokaiense"
## [598] "s__oryzoeni"
## [599] "s__iowensis"
## [600] "s__bovis"
## [601] "s__frisingensis"
## [602] "s__sp. KACC 22771"
## [603] "s__lurida"
## [604] "s__adhaerens"
## [605] "s__pontis"
## [606] "s__stewartii"
## [607] "s__sp. AA-79"
## [608] "s__pumila"
## [609] "s__sp. PSB04"
## [610] "s__insolitus"
## [611] "s__sp. BMK-MC-1"
## [612] "s__aggregans"
## [613] "s__singulare"
## [614] "s__sp. IE-0392"
## [615] "s__sp. WJP1"
## [616] "s__phaeoclathratiforme"
## [617] "s__alcaliphila"
## [618] "s__sp. E2T0"
## [619] "s__sp. AA4"
## [620] "s__limnophila"
## [621] "s__marinus"
## [622] "s__funiformis"
## [623] "s__sp. T21"
## [624] "s__sp. MSJ-33"
## [625] "s__sp. QXT-31"
## [626] "s__enoeca"
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## [627] "s__sp. M7H15-1"
## [628] "s__brassicae"
## [629] "s__sp. MMS18-M83"
## [630] "s__plakortidis"
## [631] "s__keratiniphila"
## [632] "s__wilhelmae"
## [633] "s__sp. VNUA24"
## [634] "s__citri"
## [635] "s__pneumosintes"
## [636] "s__lindanitolerans"
## [637] "s__sp. SP2"
## [638] "s__sp. SFB-rat-Yit"
## [639] "s__sp. HL-NP1"
## [640] "s__sp. 31-12"
## [641] "s__hydrogenivorans"
## [642] "s__sp. WS"
## [643] "s__paragasseri"
## [644] "s__pseudomultivorans"
## [645] "s__sp. KH172YL63"
## [646] "s__kanbiaonis"
## [647] "s__riparius"
## [648] "s__sp. JS666"
## [649] "s__chrysanthemi"
## [650] "s__cellulosilytica"
## [651] "s__subtilis"
## [652] "s__rubrisoli"
## [653] "s__taeniospiralis"
## [654] "s__stomatis"
## [655] "s__platys"
## [656] "s__florum"
## [657] "s__falkenbergense"
## [658] "s__radicidentis"
## [659] "s__sp. HUAS 3-15"
## [660] "s__sp. MZ1T"
## [661] "s__niveus"
## [662] "s__halelectricus"
## [663] "s__entomophaga"
## [664] "s__vinaceus"
## [665] "s__sp. SMC-4"
## [666] "s__sp. MW5194"
## [667] "s__sp. 313"
## [668] "s__testaceum"
## [669] "s__sp. KU28468"
## [670] "s__deserti"
## [671] "s__paraultunense"
## [672] "s__chromofuscus"
## [673] "s__aerofaciens"
## [674] "s__neapolitanus"
## [675] "s__sp. MUSA4"
## [676] "s__sp. T7-7"
## [677] "s__sp. SWIR-1"
## [678] "s__suffuscus"
## [679] "s__anyangense"
## [680] "s__sp. ATCC 8456"
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## [681] "s__coagulans"
## [682] "s__phocaicum"
## [683] "s__sp. 15-184"
## [684] "s__sp. 40"
## [685] "s__amylovorus"
## [686] "s__rodentium"
## [687] "s__leadbetteri"
## [688] "s__jeikeium"
## [689] "s__sp. WM"
## [690] "s__prydzensis"
## [691] "s__filiformis"
## [692] "s__gallolyticus"
## [693] "s__bryophila"
## [694] "s__sagamiensis"
## [695] "s__glossinidius"
## [696] "s__cryptum"
## [697] "s__sp. HWE-109"
## [698] "s__bryophytorum"
## [699] "s__chitinilytica"
## [700] "s__kloosii"
## [701] "s__camporealensis"
## [702] "s__sp. SCB32"
## [703] "s__urativorans"
## [704] "s__pygmaeum"
## [705] "s__intestinale"
## [706] "s__sp. NR 4-1"
## [707] "s__ptyseos"
## [708] "s__megaterium"
## [709] "s__sp. AT1b"
## [710] "s__siliguriense"
## [711] "s__binotii"
## [712] "s__sp. CF8"
## [713] "s__vulgaris"
## [714] "s__ginsenosidivorax"
## [715] "s__sp. HUAS 3"
## [716] "s__sp. PCC 6312"
## [717] "s__skirrowii"
## [718] "s__novalis"
## [719] "s__sp. WMMA1423"
## [720] "s__bronchiseptica"
## [721] "s__kerstersii"
## [722] "s__albida"
## [723] "s__penetrans"
## [724] "s__sediminis"
## [725] "s__hydrothermalis"
## [726] "s__sp. SGAir0479"
## [727] "s__mimigardefordensis"
## [728] "s__steedae"
## [729] "s__parmense"
## [730] "s__violascens"
## [731] "s__sp. zg.Y1379"
## [732] "s__sp. Y33"
## [733] "s__sp. SSS035"
## [734] "s__dehalogenans"
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## [735] "s__sp. SDN3"
## [736] "s__pseudotuberculosis"
## [737] "s__liquoris"
## [738] "s__subterraneus"
## [739] "s__sp. DDH964"
## [740] "s__sp. W8901"
## [741] "s__kingae"
## [742] "s__sp. HZN7"
## [743] "s__coprophilus"
## [744] "s__sp. HKB08"
## [745] "s__tropica"
## [746] "s__asahii"
## [747] "s__kondratievae"
## [748] "s__sp. EFPC3"
## [749] "s__sp. L1A9"
## [750] "s__pseudoryzae"
## [751] "s__vespae"
## [752] "s__sp. TUM22785"
## [753] "s__velox"
## [754] "s__riyadhense"
## [755] "s__thermoglucosidasius"
## [756] "s__sp. CNCTC7651"
## [757] "s__caledoniensis"
## [758] "s__sp. ZAC14D2_NAIMI4_7"
## [759] "s__sp. MPKO10"
## [760] "s__diversum"
## [761] "s__sudanensis"
## [762] "s__haliotis"
## [763] "s__stipitatus"
## [764] "s__taiwanensis"
## [765] "s__aromaticivorans"
## [766] "s__scoriae"
## [767] "s__diernhoferi"
## [768] "s__vallismortis"
## [769] "s__dendaii"
## [770] "s__sp. ABC1"
## [771] "s__grimesii"
## [772] "s__sp. 3211"
## [773] "s__caeni"
## [774] "s__sp. PCC 6303"
## [775] "s__yunxiaonensis"
## [776] "s__sp. PCC 7407"
## [777] "s__sp. Arg-1"
## [778] "s__sp. OR16"
## [779] "s__huangheensis"
## [780] "s__sp. DCT19"
## [781] "s__sp. NA02950"
## [782] "s__sp. zg-1228"
## [783] "s__sennae"
## [784] "s__aceti"
## [785] "s__saguini"
## [786] "s__sp. YF1"
## [787] "s__multocida"
## [788] "s__sp. LW097"
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## [789] "s__biformata"
## [790] "s__sp. BG1"
## [791] "s__sp. S465"
## [792] "s__sp. KCTC 42545"
## [793] "s__sp. oral taxon 169"
## [794] "s__sp. WMMA1998"
## [795] "s__sp. zg1085"
## [796] "s__gadium"
## [797] "s__sp. N1846"
## [798] "s__sp. FWC26"
## [799] "s__monophlebidarum"
## [800] "s__sp. PP1Y"
## [801] "s__sp. ZRK36"
## [802] "s__sp. MTM3W5.2"
## [803] "s__perfringens"
## [804] "s__cannabina"
## [805] "s__lenta"
## [806] "s__diekertiae"
## [807] "s__Candidatus Filomicrobium marinum"
## [808] "s__protaetiae"
## [809] "s__hiltneri"
## [810] "s__propinquum"
## [811] "s__champanellensis"
## [812] "s__uraniireducens"
## [813] "s__terrifontis"
## [814] "s__copri"
## [815] "s__cottewii"
## [816] "s__constellatus"
## [817] "s__brasilense"
## [818] "s__sp. SB155-2"
## [819] "s__imitans"
## [820] "s__sp. oral taxon 014"
## [821] "s__muciniphila"
## [822] "s__huaxiensis"
## [823] "s__sp. SGAir0287"
## [824] "s__concisus"
## [825] "s__sp. TH-20"
## [826] "s__amalonaticus"
## [827] "s__sp. FB24"
## [828] "s__renale"
## [829] "s__acidaminovorans"
## [830] "s__lwoffii"
## [831] "s__sp. MV4-Y"
## [832] "s__sp. RF6"
## [833] "s__sp. KI723T1"
## [834] "s__elongatus"
## [835] "s__marchantiae"
## [836] "s__amyloliquefaciens"
## [837] "s__fragi"
## [838] "s__altamirensis"
## [839] "s__sp. ESL0769"
## [840] "s__sp. M7A.F.Ce.TU.012.03.2.1"
## [841] "s__sp. KS 6"
## [842] "s__keddieii"
```

```
## [843] "s__antranikianii"
## [844] "s__radingae"
## [845] "s__mercurii"
## [846] "s__Enterobacteriaceae endosymbiont of Donacia cinerea"
## [847] "s__gauvreauii"
## [848] "s__ammoniagenes"
## [849] "s__thermautotrophica"
## [850] "s__sp. EGB"
## [851] "s__sp. BT18"
## [852] "s__fusiformis"
## [853] "s__sp. MLAF003"
## [854] "s__xyli"
## [855] "s__quercinecans"
## [856] "s__alcaliphilum"
## [857] "s__sp. TD01"
## [858] "s__sp. HUAS 11-8"
## [859] "s__oleivorans"
## [860] "s__terricola"
## [861] "s__muralis"
## [862] "s__acidisoli"
## [863] "s__brassicacearum"
## [864] "s__panacisoli"
## [865] "s__luhongzhouii"
## [866] "s__zhejiangensis"
## [867] "s__radioresistens"
## [868] "s__flavus"
## [869] "s__stutzeri"
## [870] "s__sp. HTCC2170"
## [871] "s__crystallopoietes"
## [872] "s__mangrovi"
## [873] "s__luteoverticillatus"
## [874] "s__gerenzanensis"
## [875] "s__debuckii"
## [876] "s__sp. MYC101"
## [877] "s__shaoguanensis"
## [878] "s__sp. L1SW"
## [879] "s__chroococcum"
## [880] "s__tamaricis"
## [881] "s__pigrum"
## [882] "s__hilgardii"
## [883] "s__saxicola"
## [884] "s__nedwellii"
## [885] "s__lipocalidus"
## [886] "s__lusitana"
## [887] "s__sp. BDJS002"
## [888] "s__sp. RS9902"
## [889] "s__sp. FDAARGOS_553"
## [890] "s__pinnipediorum"
## [891] "s__radiotolerans"
## [892] "s__sp. KUDC1026"
## [893] "s__xylanisolvens"
## [894] "s__sp. I4-3-84"
## [895] "s__nigrescens"
## [896] "s__sp. HMP6"
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## [897] "s__halophila"
## [898] "s__sp. DA14"
## [899] "s__cathodiphilus"
## [900] "s__sp. NAK00032"
## [901] "s__cinctiostellae"
## [902] "s__acetotolerans"
## [903] "s__krulwichiae"
## [904] "s__thermophila"
## [905] "s__destructor"
## [906] "s__piscis"
## [907] "s__sp. PAMC 26508"
## [908] "s__seminalis"
## [909] "s__gingivalis"
## [910] "s__sp. BC42"
## [911] "s__sticklandii"
## [912] "s__sp. GIMC2001"
## [913] "s__coryniformis"
## [914] "s__sp. Colony322"
## [915] "s__vignae"
## [916] "s__barguzinensis"
## [917] "s__sp. ANAM02"
## [918] "s__cyaneochromogenes"
## [919] "s__selenitireducens"
## [920] "s__sp. SUK 48"
## [921] "s__sp. ADAK13"
## [922] "s__sp. AK26"
## [923] "s__sp. S4.7"
## [924] "s__sp. Leaf245"
## [925] "s__variicola"
## [926] "s__aerolatus"
## [927] "s__spongiicola"
## [928] "s__palaemonis"
## [929] "s__aerolatum"
## [930] "s__sp. FDAARGOS_737"
## [931] "s__plutonius"
## [932] "s__maritimus"
## [933] "s__accolens"
## [934] "s__Verrucosispora sp. WMMD573"
## [935] "s__iners"
## [936] "s__sp. KSW4-10"
## [937] "s__thermotolerans"
## [938] "s__furukawaii"
## [939] "s__sp. PS18"
## [940] "s__sp. wkB8"
## [941] "s__clara"
## [942] "s__purpuratum"
## [943] "s__guaymasensis"
## [944] "s__sp. M3A.F.Ca.ET.080.04.2.1"
## [945] "s__pohangensis"
## [946] "s__benzenivorans"
## [947] "s__sp. RAC05"
## [948] "s__sp. FJ2-5-3"
## [949] "s__silvestris"
## [950] "s__sp. NS1(2017)"
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## [951] "s__pumilus"
## [952] "s__panisapium"
## [953] "s__sp. MP-37"
## [954] "s__portuensis"
## [955] "s__sp. XGS7"
## [956] "s__sp. 4G"
## [957] "s__sp. SK012"
## [958] "s__woosongensis"
## [959] "s__amylolytica"
## [960] "s__carnosus"
## [961] "s__sp. GSS17"
## [962] "s__nuruki"
## [963] "s__ruckeri"
## [964] "s__sp. 32O-W"
## [965] "s__propionicus"
## [966] "s__sp. LS44"
## [967] "s__chitinolytica"
## [968] "s__antarctica"
## [969] "s__sp. S190"
## [970] "s__ludwigii"
## [971] "s__kutscheri"
## [972] "s__putida"
## [973] "s__sp. NCPPB 2350"
## [974] "s__asteroides"
## [975] "s__incerta"
## [976] "s__woluwensis"
## [977] "s__haemolyticus"
## [978] "s__ferrooxidans"
## [979] "s__aquimaris"
## [980] "s__manosquense"
## [981] "s__pseudoperiodonticum"
## [982] "s__armoricus"
## [983] "s__canicola"
## [984] "s__vandammei"
## [985] "s__dumoffii"
## [986] "s__endopervernicosa"
## [987] "s__crispatus"
## [988] "s__sp. MMS16-BH015"
## [989] "s__calvum"
## [990] "s__parasyntrophica"
## [991] "s__persicina"
## [992] "s__mediterraneus"
## [993] "s__algae"
## [994] "s__carbinolica"
## [995] "s__sp. BS20"
## [996] "s__futsaii"
## [997] "s__gaoshouyii"
## [998] "s__callunae"
## [999] "s__sp. DSM 40750"
## [1000] "s__sp. 155"
## [1001] "s__sp. Lep1P3"
## [1002] "s__zoogleoformans"
## [1003] "s__psoromatis"
## [1004] "s__argentoratensis"
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## [1005] "s__sp. KK10"
## [1006] "s__tirandamycinicus"
## [1007] "s__rubeus"
## [1008] "s__sp. H30R-01"
## [1009] "s__sp. AU20"
## [1010] "s__celer"
## [1011] "s__chocolatum"
## [1012] "s__shahii"
## [1013] "s__thermocarboxydus"
## [1014] "s__japonicus"
## [1015] "s__defectiva"
## [1016] "s__indistinctus"
## [1017] "s__watsonii"
## [1018] "s__sp. NA07423"
## [1019] "s__alkaliphilus"
## [1020] "s__inaquosorum"
## [1021] "s__sp. PS1209"
## [1022] "s__caribensis"
## [1023] "s__calida"
## [1024] "s__glucanolyticus"
## [1025] "s__nitrativorans"
## [1026] "s__kumadai"
## [1027] "s__cyriacigeorgica"
## [1028] "s__panacisegetis"
## [1029] "s__phlei"
## [1030] "s__sp. BB1"
## [1031] "s__argenteus"
## [1032] "s__sp. QHH-9511"
## [1033] "s__sp. A2M4"
## [1034] "s__sp. V7"
## [1035] "s__sp. HKS 07"
## [1036] "s__[Phormidium] sp. ETS-05"
## [1037] "s__moscoviensis"
## [1038] "s__hermannii"
## [1039] "s__sp. CB3171"
## [1040] "s__sp. HM190"
## [1041] "s__jiangjiafuii"
## [1042] "s__sp. SL306"
## [1043] "s__sp. SS37A-Re"
## [1044] "s__sp. B21-019"
## [1045] "s__collinus"
## [1046] "s__ixodetis"
## [1047] "s__chiangmaiensis"
## [1048] "s__actinocoloniiforme"
## [1049] "s__halioticida"
## [1050] "s__sp. SY7"
## [1051] "s__oligotrophicum"
## [1052] "s__coriaceae"
## [1053] "s__michiganensis"
## [1054] "s__sp. BRM-1"
## [1055] "s__formosus"
## [1056] "s__Candidatus Thiodictyon syntrophicum"
## [1057] "s__papyrosolvens"
## [1058] "s__anthracis"
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## [1059] "s__methaneseepsis"
## [1060] "s__yongneupense"
## [1061] "s__flagellatus"
## [1062] "s__dentiae"
## [1063] "s__sp. PV034"
## [1064] "s__africana"
## [1065] "s__koseri"
## [1066] "s__manihotivorans"
## [1067] "s__proteoclasticus"
## [1068] "s__sichuanensis"
## [1069] "s__limicola"
## [1070] "s__paradisiaca"
## [1071] "s__limneticum"
## [1072] "s__hispaniensis"
## [1073] "s__sp. P2A-2r"
## [1074] "s__indicoceani"
## [1075] "s__sp. DBS4"
## [1076] "s__sandarakinus"
## [1077] "s__sp. JM171"
## [1078] "s__okcheonensis"
## [1079] "s__maricopensis"
## [1080] "s__japonicum"
## [1081] "s__sp. JK5"
## [1082] "s__sp. SCR221107"
## [1083] "s__acidovorans"
## [1084] "s__dalangtanensis"
## [1085] "s__sp. S13"
## [1086] "s__heliothermus"
## [1087] "s__sp. BHT-5-2"
## [1088] "s__portus"
## [1089] "s__algeriensis"
## [1090] "s__taetrolens"
## [1091] "s__sp. nov. GSS16"
## [1092] "s__cyanobacteriivorans"
## [1093] "s__chaffeensis"
## [1094] "s__producta"
## [1095] "s__sp. Minos11"
## [1096] "s__mesophilus"
## [1097] "s__sp. RS-1"
## [1098] "s__zhanjiangense"
## [1099] "s__sp. B21-038"
## [1100] "s__buccalis"
## [1101] "s__rutgersensis"
## [1102] "s__sp. 5B5"
## [1103] "s__ligni"
## [1104] "s__uliginis"
## [1105] "s__casseliflavus"
## [1106] "s__thermarum"
## [1107] "s__sp. Sym1"
## [1108] "s__sp. HMP9"
## [1109] "s__missouriensis"
## [1110] "s__gelatinilyticus"
## [1111] "s__sp. Q1-7"
## [1112] "s__sp. THAF37"
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## [1113] "s__endosymbioticus"
## [1114] "s__aurum"
## [1115] "s__bolteae"
## [1116] "s__damnosus"
## [1117] "s__tyrosinosolvens"
## [1118] "s__frequens"
## [1119] "s__irradiatisoli"
## [1120] "s__sp. HDW6A"
## [1121] "s__arcticum"
## [1122] "s__sp. CdTB01"
## [1123] "s__massiliensis"
## [1124] "s__garamanticum"
## [1125] "s__tundrae"
## [1126] "s__nakazawae"
## [1127] "s__qintianiae"
## [1128] "s__seeligeri"
## [1129] "s__ytuae"
## [1130] "s__sp. SSM4.3"
## [1131] "s__groenlandica"
## [1132] "s__oleilytica"
## [1133] "s__oxydans"
## [1134] "s__dichloroeliminans"
## [1135] "s__formosensis"
## [1136] "s__sp. KNUC1026"
## [1137] "s__apis"
## [1138] "s__zhujimingii"
## [1139] "s__peruense"
## [1140] "s__sp. Y1"
## [1141] "s__potus"
## [1142] "s__sp. DSM 9736"
## [1143] "s__sp. NBC_00162"
## [1144] "s__homolactica"
## [1145] "s__rhizosphaerae"
## [1146] "s__brevitalea"
## [1147] "s__ayderensis"
## [1148] "s__oris"
## [1149] "s__sp. VKM Ac-2801"
## [1150] "s__sp. C6131"
## [1151] "s__vesicularis"
## [1152] "s__frankenforstense"
## [1153] "s__sp. HDW14"
## [1154] "s__sp. B1ASS3"
## [1155] "s__roodepoortensis"
## [1156] "s__saccharobutylicum"
## [1157] "s__agarivorans"
## [1158] "s__coccineus"
## [1159] "s__sp. NLF-1-9"
## [1160] "s__actiniarum"
## [1161] "s__sp. FeAm09"
## [1162] "s__sp. NBC37-1"
## [1163] "s__sp. RD1"
## [1164] "s__sp. PAMC25046"
## [1165] "s__sp. MNS18"
## [1166] "s__sp. WMMD1128"
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## [1167] "s__tibetensis"
## [1168] "s__toxicus"
## [1169] "s__freundii"
## [1170] "s__sp. PET-29"
## [1171] "s__erythreum"
## [1172] "s__hydrogenophilus"
## [1173] "s__sp. NW-56"
## [1174] "s__graminis"
## [1175] "s__alba"
## [1176] "s__aubagnense"
## [1177] "s__sp. MOE7"
## [1178] "s__sp. CCGE-LA001"
## [1179] "s__sp. 113-1-2"
## [1180] "s__sp. AWRP"
## [1181] "s__fortuitum"
## [1182] "s__sp. YH-1"
## [1183] "s__sp. NIES-4073"
## [1184] "s__sp. NB0720_010"
## [1185] "s__cynos"
## [1186] "s__roseochromogenus"
## [1187] "s__curvatus"
## [1188] "s__fuchuensis"
## [1189] "s__lavamentivorans"
## [1190] "s__fastidiosum"
## [1191] "s__sp. Gsoil 351"
## [1192] "s__cashew"
## [1193] "s__sp. GAS231"
## [1194] "s__ciconiae"
## [1195] "s__sp. E85"
## [1196] "s__aliiformigenes"
## [1197] "s__sp. LPB0304"
## [1198] "s__sp. SGAir0570"
## [1199] "s__quebecense"
## [1200] "s__sp. TPU 3598"
## [1201] "s__nitroreducens"
## [1202] "s__coleopterorum"
## [1203] "s__harbinensis"
## [1204] "s__maccroryi"
## [1205] "s__horikoshii"
## [1206] "s__crossotus"
## [1207] "s__sp. PA-3-X8"
## [1208] "s__abyssicola"
## [1209] "s__sp. L5"
## [1210] "s__nonliquefaciens"
## [1211] "s__sp. LL1"
## [1212] "s__sp. I3-3-89"
## [1213] "s__pulmonis"
## [1214] "s__sp. NJN-50"
## [1215] "s__genomosp. 1"
## [1216] "s__spinosa"
## [1217] "s__sp. TN58"
## [1218] "s__sp. SL48"
## [1219] "s__sp. GAS493"
## [1220] "s__extremaustralis"
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## [1221] "s__delbrueckii"
## [1222] "s__aquilus"
## [1223] "s__sp. ALW1"
## [1224] "s__animalis"
## [1225] "s__aureus"
## [1226] "s__sp. ZAC14D2_NAIMI4_6"
## [1227] "s__hyodysenteriae"
## [1228] "s__sp. FD7"
## [1229] "s__sp. KACC 21273"
## [1230] "s__piscinae"
## [1231] "s__sp. FJAT-53532"
## [1232] "s__daphniae"
## [1233] "s__rouxii"
## [1234] "s__quasivariicola"
## [1235] "s__sp. S8"
## [1236] "s__atlanticus"
## [1237] "s__persephone"
## [1238] "s__alni"
## [1239] "s__eutactus"
## [1240] "s__rhizophila"
## [1241] "s__caeruleus"
## [1242] "s__sp. BIHB 4019"
## [1243] "s__fascians"
## [1244] "s__hampsonii"
## [1245] "s__sp. MA"
## [1246] "s__sp. SYP-A7193"
## [1247] "s__tundricola"
## [1248] "s__aeolianus"
## [1249] "s__oralis"
## [1250] "s__daejeonensis"
## [1251] "s__atlantica"
## [1252] "s__coeruleorubidus"
## [1253] "s__sp. RM10537"
## [1254] "s__sp. mosi_1"
## [1255] "s__kubicae"
## [1256] "s__rubi"
## [1257] "s__sp. CA-293567"
## [1258] "s__sp. Hama-1"
## [1259] "s__ossetica"
## [1260] "s__sp. SL4(2022)"
## [1261] "s__johnsonii"
## [1262] "s__sp. ZF2019"
## [1263] "s__sp. J223"
## [1264] "s__fragariae"
## [1265] "s__sp. N1-1"
## [1266] "s__megalosphaeroides"
## [1267] "s__fungicidicus"
## [1268] "s__tuberculostearicum"
## [1269] "s__sp. CBA3647"
## [1270] "s__sp. IIBBL 290-4"
## [1271] "s__salinus"
## [1272] "s__sp. AM1P"
## [1273] "s__otitidiscaviarum"
## [1274] "s__sp. DG15C"
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```
## [1275] "s__genomosp. 9"
## [1276] "s__antarcticus"
## [1277] "s__glucuronolyticum"
## [1278] "s__calidifontis"
## [1279] "s__kilaueensis"
## [1280] "s__sp. BJA-103"
## [1281] "s__kivui"
## [1282] "s__thiophilum"
## [1283] "s__sp. I52.16.1"
## [1284] "s__kefiranofaciens"
## [1285] "s__garvieae"
## [1286] "s__sp. Crenshaw"
## [1287] "s__jordaniae"
## [1288] "s__sp. CCBAU 051011"
## [1289] "s__pretiosum"
## [1290] "s__coralli"
## [1291] "s__sp. XCS3"
## [1292] "s__sp. JZ16"
## [1293] "s__sp. SD17-2"
## [1294] "s__sp. ZC-3"
## [1295] "s__sp. WL3"
## [1296] "s__fergusonii"
## [1297] "s__viridis"
## [1298] "s__[Ruminococcus] torques"
## [1299] "s__californiensis"
## [1300] "s__sp. S132"
## [1301] "s__violaceinigra"
## [1302] "s__sp. SCLZS86"
## [1303] "s__baarsii"
## [1304] "s__sp. PK01"
## [1305] "s__corrugata"
## [1306] "s__sp. MUD61"
## [1307] "s__eckloniae"
## [1308] "s__tunisiensis"
## [1309] "s__piersonii"
## [1310] "s__ganghwensis"
## [1311] "s__sp. BPTC-684"
## [1312] "s__paraseoulense"
## [1313] "s__glumae"
## [1314] "s__protegens"
## [1315] "s__pituitosa"
## [1316] "s__sp. PAMC 29334"
## [1317] "s__sp. E13-17"
## [1318] "s__festucae"
## [1319] "s__vaginalis"
## [1320] "s__inquinata"
## [1321] "s__phaseoli"
## [1322] "s__azorensis"
## [1323] "s__sp. SSTM10-2"
## [1324] "s__gallinarum"
## [1325] "s__chengduensis"
## [1326] "s__caoxuetaonis"
## [1327] "s__sp. WMMD882"
## [1328] "s__sp. CBW1107"
```

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## [1329] "s__fakonensis"
## [1330] "s__anthropi"
## [1331] "s__sp. URB8-2"
## [1332] "s__gaofuii"
## [1333] "s__omphalii"
## [1334] "s__yanjiei"
## [1335] "s__sp. LMS18"
## [1336] "s__pulveris"
## [1337] "s__kefiri"
## [1338] "s__chromogenes"
## [1339] "s__sp. THAF27"
## [1340] "s__sp. JQ2195"
## [1341] "s__palmae"
## [1342] "s__sp. AL041005-10"
## [1343] "s__albata"
## [1344] "s__sp. 9128"
## [1345] "s__testudinoris"
## [1346] "s__paneuropaeus"
## [1347] "s__paraterrae"
## [1348] "s__pickettii"
## [1349] "s__aminophilus"
## [1350] "s__hydrolyticus"
## [1351] "s__sp. W027"
## [1352] "s__entomophilus"
## [1353] "s__kaempferiae"
## [1354] "s__sp. PCC 7116"
## [1355] "s__sp. FSL R7-0331"
## [1356] "s__xylosus"
## [1357] "s__sp. SMJS2"
## [1358] "s__nantongensis"
## [1359] "s__sp. G0186"
## [1360] "s__pseudoflava"
## [1361] "s__sp. SCSIO W0465"
## [1362] "s__lovleyi"
## [1363] "s__mediterranea"
## [1364] "s__baratii"
## [1365] "s__liquefaciens"
## [1366] "s__donggukensis"
## [1367] "s__borealis"
## [1368] "s__asparagiformis"
## [1369] "s__antimycoticus"
## [1370] "s__tanashiensis"
## [1371] "s__salivarius"
## [1372] "s__turgidum"
## [1373] "s__xanthii"
## [1374] "s__sp. OE 28.3"
## [1375] "s__sphenoides"
## [1376] "s__albidiflava"
## [1377] "s__pudoricolor"
## [1378] "s__sp. SCSIO W1103"
## [1379] "s__angustmyceticus"
## [1380] "s__agamarum"
## [1381] "s__alginolyticus"
## [1382] "s__sp. THN1"
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## [1383] "s__africae"
## [1384] "s__umbonata"
## [1385] "s__radiopugnans"
## [1386] "s__arsenatis"
## [1387] "s__sp. JC009"
## [1388] "s__apisilvae"
## [1389] "s__sp. CCMP332"
## [1390] "s__sacchari"
## [1391] "s__sp. J315"
## [1392] "s__succinogenes"
## [1393] "s__buecherae"
## [1394] "s__sp. NA04385"
## [1395] "s__sp. M2A.F.Ca.ET.043.05.1.1"
## [1396] "s__sp. GAM44"
## [1397] "s__varigena"
## [1398] "s__sp. LV10R510-11A"
## [1399] "s__formigenes"
## [1400] "s__pacaensis"
## [1401] "s__saudimassiliensis"
## [1402] "s__sp. AD91A"
## [1403] "s__sp. JMULE5"
## [1404] "s__resistens"
## [1405] "s__wenzhouensis"
## [1406] "s__sp. NHP19-003"
## [1407] "s__stercoris"
## [1408] "s__nenjiangensis"
## [1409] "s__daejeonense"
## [1410] "s__sp. HSG2"
## [1411] "s__sp. NCRR"
## [1412] "s__drozdowiczii"
## [1413] "s__sunyaminii"
## [1414] "s__album"
## [1415] "s__veronii"
## [1416] "s__pulmonicola"
## [1417] "s__sp. LS.1a"
## [1418] "s__sp. 29361"
## [1419] "s__sp. H6"
## [1420] "s__sp. G2S3"
## [1421] "s__sp. SL250"
## [1422] "s__methylotrophus"
## [1423] "s__quasipneumoniae"
## [1424] "s__cyaneogriseus"
## [1425] "s__lloydii"
## [1426] "s__rivuli"
## [1427] "s__sp. NIES-4102"
## [1428] "s__degradans"
## [1429] "s__riograndensis"
## [1430] "s__baixiangningiae"
## [1431] "s__sp. 107-1"
## [1432] "s__tritici"
## [1433] "s__sp. BT-42-2"
## [1434] "s__paurometabola"
## [1435] "s__cloacae"
## [1436] "s__warabiya"
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## [1437] "s__nigra"
## [1438] "s__sp. BT-123"
## [1439] "s__faecium"
## [1440] "s__phenanthrenivorans"
## [1441] "s__sp. WAC00303"
## [1442] "s__sp. XGS-02"
## [1443] "s__sp. ArI3"
## [1444] "s__sp. R56"
## [1445] "s__carbinoliphilus"
## [1446] "s__mucilaginosus"
## [1447] "s__sp. 'Peltigera membranacea cyanobiont' N6"
## [1448] "s__thermosuccinogenes"
## [1449] "s__haemolysans"
## [1450] "s__elongata"
## [1451] "s__sp. NBH87"
## [1452] "s__espanaensis"
## [1453] "s__portucalensis"
## [1454] "s__alkalisoli"
## [1455] "s__paucimobilis"
## [1456] "s__sp. Pc102"
## [1457] "s__magna"
## [1458] "s__sp. FDAARGOS 1241"
## [1459] "s__Candidatus Protofrankia datiscae"
## [1460] "s__albidus"
## [1461] "s__bogorensis"
## [1462] "s__somerae"
## [1463] "s__xylosoxidans"
## [1464] "s__indicus"
## [1465] "s__hominis"
## [1466] "s__dysgalactiae"
## [1467] "s__sp. LQ25"
## [1468] "s__sp. RTd22"
## [1469] "s__sp. Jing01"
## [1470] "s__brasiliense"
## [1471] "s__allomyrinae"
## [1472] "s__azurea"
## [1473] "s__baculatum"
## [1474] "s__phytophila"
## [1475] "s__yayanosii"
## [1476] "s__sp. DH3716P"
## [1477] "s__sp. BT-177"
## [1478] "s__aminovorans"
## [1479] "s__sp. F8"
## [1480] "s__pacifica"
## [1481] "s__thiotaurini"
## [1482] "s__goodwinii"
## [1483] "s__haemolytica"
## [1484] "s__[Ochrobactrum] quorumnocens"
## [1485] "s__promysalinigenes"
## [1486] "s__sp. CC9605"
## [1487] "s__sp. FDAARGOS 1415"
## [1488] "s__metalliredigens"
## [1489] "s__plymuthica"
## [1490] "s__sp. Tan611"
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## [1491] "s__bombintestini"
## [1492] "s__sp. LRE541"
## [1493] "s__urogenitale"
## [1494] "s__sp. RC67"
## [1495] "s__sp. M166"
## [1496] "s__liliifuscus"
## [1497] "s__cholerae"
## [1498] "s__flocculans"
## [1499] "s__sp. SAU14A_NAIMI4_5"
## [1500] "s__sp. ZJ106"
## [1501] "s__syringae group genomosp. 7"
## [1502] "s__telluris"
## [1503] "s__terrenum"
## [1504] "s__konosiri"
## [1505] "s__equorum"
## [1506] "s__sp. JZB09"
## [1507] "s__sp. THAF12"
## [1508] "s__sp. CNQ-509"
## [1509] "s__rotundus"
## [1510] "s__lablabi"
## [1511] "s__glycaniphila"
## [1512] "s__sp. SO1"
## [1513] "s__aromatica"
## [1514] "s__sp. Colony194"
## [1515] "s__caseolyticus"
## [1516] "s__zosterae"
## [1517] "s__sp. CZR27"
## [1518] "s__osloensis"
## [1519] "s__pasteurii"
## [1520] "s__intracellularis"
## [1521] "s__fallax"
## [1522] "s__bifermentans"
## [1523] "s__sp. 5413J-13"
## [1524] "s__sp. SK50-23"
## [1525] "s__acetigenes"
## [1526] "s__sp. WMMA1947"
## [1527] "s__chauvoei"
## [1528] "s__venezuelae"
## [1529] "s__sp. WAC 01438"
## [1530] "s__arginini"
## [1531] "s__oryzicola"
## [1532] "s__aureoverticillatus"
## [1533] "s__sp. QY071"
## [1534] "s__sp. SG1"
## [1535] "s__versatilis"
## [1536] "s__sp. WMMD812"
## [1537] "s__sp. SA4125"
## [1538] "s__albus"
## [1539] "s__sulfuroxidans"
## [1540] "s__baengnokdamensis"
## [1541] "s__allii"
## [1542] "s__sp. OT7"
## [1543] "s__sp. FDAARGOS 1409"
## [1544] "s__urinaehominis"
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## [1545] "s__sp. OxB-1"
## [1546] "s__sp. Bac332"
## [1547] "s__abscessus"
## [1548] "s__sp. JM1"
## [1549] "s__nigripulchritudo"
## [1550] "s__sp. M30-35"
## [1551] "s__methanolica"
## [1552] "s__sp. MR_MD2014"
## [1553] "s__sp. YPW1"
## [1554] "s__phytofermentans"
## [1555] "s__sp. HUAS 15-9"
## [1556] "s__[Clostridium] colinum"
## [1557] "s__sp. 113P3"
## [1558] "s__chenweiae"
## [1559] "s__metallilatus"
## [1560] "s__hygroscopicus"
## [1561] "s__penaei"
## [1562] "s__sp. CX169"
## [1563] "s__coccoides"
## [1564] "s__guangzhouensis"
## [1565] "s__arabaticum"
## [1566] "s__sp. PAMC26645"
## [1567] "s__sp. VKM Ac-2759"
## [1568] "s__pnomenusa"
## [1569] "s__pseudoxylosus"
## [1570] "s__singaporensis"
## [1571] "s__ferrireducens"
## [1572] "s__sp. NFH-SH190041"
## [1573] "s__chenwenguii"
## [1574] "s__echinicola"
## [1575] "s__abortibovis"
## [1576] "s__sp. QL22"
## [1577] "s__autotrophicum"
## [1578] "s__lutrae"
## [1579] "s__lunaelactis"
## [1580] "s__phocaeense"
## [1581] "s__alcaligenes"
## [1582] "s__aquatilis"
## [1583] "s__litorale"
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## [1585] "s__cervicalis"
## [1586] "s__sp. IMCC11727"
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## [1588] "s__sp. ESL0785"
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## [1590] "s__americana"
## [1591] "s__caseinilytica"
## [1592] "s__vulnificus"
## [1593] "s__cinaedi"
## [1594] "s__rimosus"
## [1595] "s__oleovorans"
## [1596] "s__novyi"
## [1597] "s__sp. G2-5"
## [1598] "s__sp. XC 2026"
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## [1599] "s__kimnyeongensis"
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## [1601] "s__sp. oral taxon 218"
## [1602] "s__brandeum"
## [1603] "s__iranensis"
## [1604] "s__similis"
## [1605] "s__japonica"
## [1606] "s__sp. CB1650"
## [1607] "s__antibioticus"
## [1608] "s__mucosae"
## [1609] "s__sp. INOP01"
## [1610] "s__piscicola"
## [1611] "s__uncultured bacterium"
## [1612] "s__sp. CY52-2"
## [1613] "s__sp. WL1"
## [1614] "s__echinospora"
## [1615] "s__opportunistum"
## [1616] "s__sp. Z423-1"
## [1617] "s__arabiense"
## [1618] "s__dextrinosolvens"
## [1619] "s__gottheilii"
## [1620] "s__lizhenjunii"
## [1621] "s__avenae"
## [1622] "s__actuosus"
## [1623] "s__sp. Bac330"
## [1624] "s__sp. D2"
## [1625] "s__cellulans"
## [1626] "s__pristinaespiralis"
## [1627] "s__xylaniphila"
## [1628] "s__phagedenis"
## [1629] "s__brevissima"
## [1630] "s__ignavus"
## [1631] "s__microaerophilus"
## [1632] "s__halocryophilus"
## [1633] "s__avicenniae"
## [1634] "s__sprentiae"
## [1635] "s__sp. PIV-1"
## [1636] "s__sp. FDAARGOS_375"
## [1637] "s__sp. WB-2"
## [1638] "s__fusca"
## [1639] "s__himalayensis"
## [1640] "s__tanakiae"
## [1641] "s__sp. MEDNS5"
## [1642] "s__chagasii"
## [1643] "s__innocua"
## [1644] "s__pinensis"
## [1645] "s__sinuspersici"
## [1646] "s__cowanii"
## [1647] "s__rhodesiae"
## [1648] "s__sp. 336/3"
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## [1651] "s__richardii"
## [1652] "s__candidum"
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## [1654] "s__temperans"
## [1655] "s__tolaasii"
## [1656] "s__violaceusniger"
## [1657] "s__sp. LG1267"
## [1658] "s__sp. KACC 23028"
## [1659] "s__atlantisensis"
## [1660] "s__fredii"
## [1661] "s__sp. WH 8020"
## [1662] "s__sp. M6A.T.Cr.TU.016.01.1.1"
## [1663] "s__sp. NRS527"
## [1664] "s__sobrinus"
## [1665] "s__alleghenense"
## [1666] "s__vicinigordonae"
## [1667] "s__sp. YPD9-1"
## [1668] "s__pumilum"
## [1669] "s__lithotrophicum"
## [1670] "s__ectocarpi"
## [1671] "s__sp. Y32M11"
## [1672] "s__toyakuensis"
## [1673] "s__phaeovibrioides"
## [1674] "s__sp. 3H"
## [1675] "s__sp. S1D4-14"
## [1676] "s__sp. CKK8"
## [1677] "s__lilanjuaniae"
## [1678] "s__sp. YG1"
## [1679] "s__acetoxydans"
## [1680] "s__sp. Hal144"
## [1681] "s__sp. AM 2-1-1"
## [1682] "s__delphini"
## [1683] "s__sp. CCB-MM3"
## [1684] "s__malmoense"
## [1685] "s__sp. OPL5"
## [1686] "s__olearia"
## [1687] "s__clausii"
## [1688] "s__brachiatum"
## [1689] "s__eggerthii"
## [1690] "s__sp. ZY201224"
## [1691] "s__sp. THAF30"
## [1692] "s__influenzae"
## [1693] "s__sp. S6"
## [1694] "s__axanthum"
## [1695] "s__sp. HBX-1"
## [1696] "s__sp. AH1"
## [1697] "s__towneri"
## [1698] "s__flexa"
## [1699] "s__tuirus"
## [1700] "s__faecalis"
## [1701] "s__sp. Go-475"
## [1702] "s__ratti"
## [1703] "s__sp. St316"
## [1704] "s__pseudogrignonensis"
## [1705] "s__Blochmannia endosymbiont of Polyrhachis (Hedomyrma) turneri"
## [1706] "s__tractuosa"
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## [1707] "s__sp. HKU1"
## [1708] "s__poaceiphila"
## [1709] "s__ferriphilum"
## [1710] "s__damselae"
## [1711] "s__media"
## [1712] "s__Enterobacteriaceae endosymbiont of Donacia tomentosa"
## [1713] "s__panamensis"
## [1714] "s__carniphilus"
## [1715] "s__methoxysyntrophicus"
## [1716] "s__capnotolerans"
## [1717] "s__diazotrophicus"
## [1718] "s__sp. SL47"
## [1719] "s__phosphovorus"
## [1720] "s__vincentii"
## [1721] "s__sp. M41"
## [1722] "s__sp. WS11"
## [1723] "s__sp. G01H"
## [1724] "s__simplex"
## [1725] "s__hydrophila"
## [1726] "s__aidingensis"
## [1727] "s__thermoresistibile"
## [1728] "s__sp. BPS33"
## [1729] "s__brasilensis"
## [1730] "s__sp. E15-22"
## [1731] "s__jaguaris"
## [1732] "s__phocoenae"
## [1733] "s__vanderleydeniana"
## [1734] "s__sp. LM7"
## [1735] "s__zhachilii"
## [1736] "s__sp. 63ED37-2"
## [1737] "s__cytotoxicus"
## [1738] "s__saxobsidens"
## [1739] "s__terrigena"
## [1740] "s__vaccinii"
## [1741] "s__sp. H121"
## [1742] "s__daltonii"
## [1743] "s__pediculischaeffi"
## [1744] "s__aquaticum"
## [1745] "s__humicireducens"
## [1746] "s__genisteinicus"
## [1747] "s__sp. PMCC200344"
## [1748] "s__pentosaceus"
## [1749] "s__phocisimile"
## [1750] "s__sp. CCB-ST2H9"
## [1751] "s__degensii"
## [1752] "s__sp. B32"
## [1753] "s__jordanis"
## [1754] "s__warneri"
## [1755] "s__sp. PCC 7327"
## [1756] "s__ammonigenes"
## [1757] "s__blattae"
## [1758] "s__wieringae"
## [1759] "s__cavernae"
## [1760] "s__medellinensis"
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## [1761] "s__tardum"
## [1762] "s__crateris"
## [1763] "s__senegalensis"
## [1764] "s__paucivorans"
## [1765] "s__megapolitana"
## [1766] "s__sp. WMMD987"
## [1767] "s__sp. 3214.6"
## [1768] "s__botulinum"
## [1769] "s__composti"
## [1770] "s__sp. 1566"
## [1771] "s__orientale"
## [1772] "s__sp. MTM4"
## [1773] "s__auricularis"
## [1774] "s__hongtaonis"
## [1775] "s__monticola"
## [1776] "s__sp. MC1825"
## [1777] "s__incomptus"
## [1778] "s__lactatiformans"
## [1779] "s__pukyongi"
## [1780] "s__stabekisii"
## [1781] "s__pantholopis"
## [1782] "s__multitudinisentens"
## [1783] "s__sp. No. 7"
## [1784] "s__urinaeequi"
## [1785] "s__sp. P6W"
## [1786] "s__nojiriensis"
## [1787] "s__vibrioformis"
## [1788] "s__tructae"
## [1789] "s__sp. AM 4-1-1"
## [1790] "s__lichenicola"
## [1791] "s__Verrucosispora sp. WMMD1129"
## [1792] "s__sp. AGMB13025"
## [1793] "s__hwasookii"
## [1794] "s__bohemicus"
## [1795] "s__lividus"
## [1796] "s__minnesotensis"
## [1797] "s__nucleatum"
## [1798] "s__paludicola"
## [1799] "s__fermenticellae"
## [1800] "s__heliotrinireducens"
## [1801] "s__sp. JS3050"
## [1802] "s__[Acidovorax] ebreus"
## [1803] "s__furrinae"
## [1804] "s__sp. QJXJ"
## [1805] "s__verrucosospora"
## [1806] "s__rhamnosivorans"
## [1807] "s__carboxydovora"
## [1808] "s__barranii"
## [1809] "s__helveticus"
## [1810] "s__callanderi"
## [1811] "s__capsulatus"
## [1812] "s__aerodenitrificans"
## [1813] "s__griseus"
## [1814] "s__tertiaricarbonis"
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## [1815] "s__sera"
## [1816] "s__pseudogenitalium"
## [1817] "s__azadirachtae"
## [1818] "s__sp. WMMD998"
## [1819] "s__sp. MI1205"
## [1820] "s__felsineum"
## [1821] "s__sp. AR10"
## [1822] "s__sp. GDN1"
## [1823] "s__sp. M28"
## [1824] "s__clevelandensis"
## [1825] "s__sp. MB-3u-03"
## [1826] "s__sp. 116-D4"
## [1827] "s__sp. BIM B-2242"
## [1828] "s__sp. HF-162"
## [1829] "s__tubbatahanensis"
## [1830] "s__sp. RPA4-2"
## [1831] "s__newyorkensis"
## [1832] "s__anaerobius"
## [1833] "s__sp. 8"
## [1834] "s__halichoeri"
## [1835] "s__sp. ZAC14D1_NAIMI4_6"
## [1836] "s__asoensis"
## [1837] "s__sp. 'AMD consortium'"
## [1838] "s__sp. NIV53"
## [1839] "s__lydicamycinicus"
## [1840] "s__fuliginis"
## [1841] "s__phasianinus"
## [1842] "s__sp. XAAS-72"
## [1843] "s__flavescens"
## [1844] "s__alvei"
## [1845] "s__alsatica"
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## [1847] "s__aeria"
## [1848] "s__schaalii"
## [1849] "s__cadmiisoli"
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## [1862] "s__phragmitis"
## [1863] "s__muris"
## [1864] "s__dextrinicus"
## [1865] "s__wiegelii"
## [1866] "s__hippikon"
## [1867] "s__thermocellus"
## [1868] "s__sp. Z2-YC6860"
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## [1872] "s__hoggarensis"
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## [1874] "s__sp. J780"
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## [1876] "s__sp. ZQ21"
## [1877] "s__sp. WZ-12"
## [1878] "s__sp. EFPC2"
## [1879] "s__sp. LW-XY12"
## [1880] "s__roseum"
## [1881] "s__sp. CBA3646"
## [1882] "s__sp. BAB1"
## [1883] "s__sp. LM2"
## [1884] "s__sp. FXJ1.172"
## [1885] "s__ferragutiae"
## [1886] "s__novella"
## [1887] "s__ampullae"
## [1888] "s__sp. B7740"
## [1889] "s__sp. LTJR-52"
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## [1892] "s__sp. UTMC 2448"
## [1893] "s__lusitanus"
## [1894] "s__rubidaea"
## [1895] "s__porci"
## [1896] "s__arctica"
## [1897] "s__sp. KMM 9044"
## [1898] "s__sp. N12"
## [1899] "s__bacteriovorus"
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## [1901] "s__sp. AA-38"
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## [1904] "s__pseudolwoffii"
## [1905] "s__sp. B01"
## [1906] "s__sp. CENA543"
## [1907] "s__hordei"
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## [1910] "s__sp. LMS25"
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## [1912] "s__sp. BN140058"
## [1913] "s__sp. AN1"
## [1914] "s__sp. BT304"
## [1915] "s__jejuense"
## [1916] "s__caprae"
## [1917] "s__sp. RHB25-C09"
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## [1919] "s__ampelinum"
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## [1922] "s__sordellii"
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## [1925] "s__argentinense"
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## [1930] "s__sp. (ex Adelges kitamiensis)"
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## [1934] "s__sp. JSBI002"
## [1935] "s__fulvum"
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## [1972] "s__sp. B11D7D"
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## [1975] "s__simulans"
## [1976] "s__apicola"
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## [1987] "s__cellobiosedens"
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## [1997] "s__quintilis"
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## [2000] "s__sp. SFB-mouse-NL"
## [2001] "s__sp. TT6"
## [2002] "s__sp. oral taxon 136"
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## [2004] "s__avermitilis"
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## [2015] "s__hattorii"
## [2016] "s__centrodinii"
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## [2019] "s__diazoefficiens"
## [2020] "s__beijingensis"
## [2021] "s__lemovicicum"
## [2022] "s__sp. zg-570"
## [2023] "s__onderdonkii"
## [2024] "s__sp. VKM Ac-2804"
## [2025] "s__wuliandei"
## [2026] "s__faecis"
## [2027] "s__sp. PBC"
## [2028] "s__microcystinivorans"
## [2029] "s__sp. K11"
## [2030] "s__sp. Pdp11"
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## [2033] "s__kobayashii"
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## [2035] "s__sp. DSM 15011"
## [2036] "s__sp. NBRC 113351"
## [2037] "s__sp. P11F6"
## [2038] "s__xiejunii"
## [2039] "s__iocasae"
## [2040] "s__spirulinae"
## [2041] "s__timorensis"
## [2042] "s__ureae"
## [2043] "s__mexicanum"
## [2044] "s__akajimensis"
## [2045] "s__pernigra"
## [2046] "s__cystitidis"
## [2047] "s__sp. L1I39"
## [2048] "s__pacificus"
## [2049] "s__aegosomatis"
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## [2051] "s__pseudonitzschiae"
## [2052] "s__sp. 24S4-2"
## [2053] "s__sp. AMCC400023"
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## [2055] "s__kanasensis"
## [2056] "s__solisilvae"
## [2057] "s__ficellus"
## [2058] "s__alfacsensis"
## [2059] "s__sp. MM211"
## [2060] "s__terrestris"
## [2061] "s__sp. LM091"
## [2062] "s__psychrophila"
## [2063] "s__solanacearum"
## [2064] "s__sp. 391_Methyba4"
## [2065] "s__sp. HDW16"
## [2066] "s__matsuzakiense"
## [2067] "s__crocodyli"
## [2068] "s__sp. (ex Biomphalaria glabrata)"
## [2069] "s__orenii"
## [2070] "s__sp. MMS21-STM26"
## [2071] "s__ihumii"
## [2072] "s__morganii"
## [2073] "s__guodeyinii"
## [2074] "s__yudongzhengii"
## [2075] "s__sp. L9-4"
## [2076] "s__endosymbiont of Aphis craccivora"
## [2077] "s__Candidatus Erwinia haradaeae"
## [2078] "s__wasabiae"
## [2079] "s__sp. YRD-M1"
## [2080] "s__marinisabuli"
## [2081] "s__euroxanthea"
## [2082] "s__marensis"
## [2083] "s__moniliformis"
## [2084] "s__oleronia"
```

```
## [2085] "s__sp. A18JL241"
## [2086] "s__aquatica"
## [2087] "s__sp. YGSMI21"
## [2088] "s__deccanensis"
## [2089] "s__griseochromogenes"
## [2090] "s__sp. FF17"
## [2091] "s__bovirhinis"
## [2092] "s__sp. BH-2-1-1"
## [2093] "s__amylovora"
## [2094] "s__sp. H12"
## [2095] "s__urinae"
## [2096] "s__limnaeum"
## [2097] "s__abyssalis"
## [2098] "s__xanthus"
## [2099] "s__aespoeensis"
## [2100] "s__sp. SGAir0440"
## [2101] "s__formicigenerans"
## [2102] "s__saurashtrense"
## [2103] "s__sp. ESL0704"
## [2104] "s__vinelandii"
## [2105] "s__huttiense"
## [2106] "s__sp. USK10"
## [2107] "s__dongpingensis"
## [2108] "s__sp. SS4"
## [2109] "s__sp. 3AFRM03"
## [2110] "s__glaciei"
## [2111] "s__subtropicus"
## [2112] "s__sambongensis"
## [2113] "s__sp. G11"
## [2114] "s__sp. SCSIO 43209"
## [2115] "s__catena"
## [2116] "s__fodineus"
## [2117] "s__sp. AB2/73"
## [2118] "s__sp. MYC340"
## [2119] "s__mannosilyticum"
## [2120] "s__sp. Rep29"
## [2121] "s__ethanolicus"
## [2122] "s__junii"
## [2123] "s__herbicidovorans"
## [2124] "s__weilii"
## [2125] "s__canadensis"
## [2126] "s__rugosus"
## [2127] "s__elgii"
## [2128] "s__humireducens"
## [2129] "s__sp. KBS0714"
## [2130] "s__myxofaciens"
## [2131] "s__veroralis"
## [2132] "s__hortorum"
## [2133] "s__cerasi"
## [2134] "s__globisporus"
## [2135] "s__erythraea"
## [2136] "s__fastidiosa"
## [2137] "s__yamanashiensis"
## [2138] "s__sp. ATCC 53434"
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## [2139] "s__australiensis"
## [2140] "s__sp. ORS 278"
## [2141] "s__thalpophilum"
## [2142] "s__sp. DD4"
## [2143] "s__paradoxus"
## [2144] "s__yeei"
## [2145] "s__etheniformans"
## [2146] "s__luteolum"
## [2147] "s__sp. 71268"
## [2148] "s__aureofaciens"
## [2149] "s__gracilis"
## [2150] "s__xylanilyticum"
## [2151] "s__miscanthi"
## [2152] "s__formicaceticum"
## [2153] "s__luteoviolacea"
## [2154] "s__sp. PSBB021"
## [2155] "s__beveridgei"
## [2156] "s__gregorii"
## [2157] "s__seonyuensis"
## [2158] "s__sp. DNA4"
## [2159] "s__chlorophenolicus"
## [2160] "s__cremea"
## [2161] "s__sp. 1513"
## [2162] "s__sp. LGH"
## [2163] "s__sp. 2017"
## [2164] "s__fallonii"
## [2165] "s__agalactiae"
## [2166] "s__canis"
## [2167] "s__nodulans"
## [2168] "s__aureum"
## [2169] "s__sp. M9A.F.Ca.ET.002.03.1.2"
## [2170] "s__mendocina"
## [2171] "s__toyohensis"
## [2172] "s__propionicigenes"
## [2173] "s__gephyra"
## [2174] "s__muelleri"
## [2175] "s__aminofermentans"
## [2176] "s__genomosp. 13"
## [2177] "s__stygius"
## [2178] "s__sp. Dgby_cultured_2"
## [2179] "s__glycinis"
## [2180] "s__arsenicus"
## [2181] "s__sp. Marseille-Q4369"
## [2182] "s__sp. USDA-ARS-USMARC-1261"
## [2183] "s__marisgermanici"
## [2184] "s__lari"
## [2185] "s__mongolicus"
## [2186] "s__tengchongensis"
## [2187] "s__gordoniae"
## [2188] "s__stantonii"
## [2189] "s__pallida"
## [2190] "s__megaguti"
## [2191] "s__cellulosilyticus"
## [2192] "s__sp. zg-Y815"
```

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## [2193] "s__sp. I2-3-92"
## [2194] "s__validum"
## [2195] "s__ceratoperidinii"
## [2196] "s__sp. AN-B15"
## [2197] "s__nassauensis"
## [2198] "s__sp. ES.047"
## [2199] "s__brasiliensis"
## [2200] "s__colihominis"
## [2201] "s__xylanolyticum"
## [2202] "s__maltosivorans"
## [2203] "s__sp. SO9"
## [2204] "s__sp. IMCC34515"
## [2205] "s__malefermentans"
## [2206] "s__wangleii"
## [2207] "s__endosymbiont of Folsomia candida"
## [2208] "s__sp. NIC1"
## [2209] "s__rhapontici"
## [2210] "s__sp. SL43"
## [2211] "s__sp. PHS-Z3"
## [2212] "s__sp. SGAir0207"
## [2213] "s__potens"
## [2214] "s__jejuensis"
## [2215] "s__sp. CIAT894"
## [2216] "s__sp. SL257"
## [2217] "s__sp. CBW1006"
## [2218] "s__sp. GSS18"
## [2219] "s__qinghaiensis"
## [2220] "s__taeniosporum"
## [2221] "s__glucosotrophus"
## [2222] "s__sp. SUR17"
## [2223] "s__sp. ABG19"
## [2224] "s__sp. HM134"
## [2225] "s__rhizovicinus"
## [2226] "s__aceticum"
## [2227] "s__cadaveris"
## [2228] "s__sp. K"
## [2229] "s__versutus"
## [2230] "s__sp. J8"
## [2231] "s__navarrensis"
## [2232] "s__amphilecti"
## [2233] "s__peucetius"
## [2234] "s__sp. zg-629"
## [2235] "s__mucilyticum"
## [2236] "s__triazinivorans"
## [2237] "s__sp. dk2585"
## [2238] "s__equikiangi"
## [2239] "s__caulinodans"
## [2240] "s__lalkuanensis"
## [2241] "s__Candidatus Thiothrix anitrata"
## [2242] "s__vesiculosa"
## [2243] "s__pleomorphus"
## [2244] "s__sp. CBA3108"
## [2245] "s__fodinaquatile"
## [2246] "s__dangxiongensis"
```

```
## [2247] "s__exigua"
## [2248] "s__termitida"
## [2249] "s__laidlawii"
## [2250] "s__sp. H4-D48"
## [2251] "s__vulgatus"
## [2252] "s__caniscabiei"
## [2253] "s__sp. TXMA1"
## [2254] "s__sp. A7"
## [2255] "s__sp. CJ23"
## [2256] "s__sp. 18071143"
## [2257] "s__sp. wino2"
## [2258] "s__frisingense"
## [2259] "s__paralvei"
## [2260] "s__sp. HKS02"
## [2261] "s__sp. ZHDP1"
## [2262] "s__byssophila"
## [2263] "s__sp. CD1"
## [2264] "s__periodonticum"
## [2265] "s__sp. Ost2"
## [2266] "s__chartreusis"
## [2267] "s__uberis"
## [2268] "s__sp. Csp2"
## [2269] "s__sp. RtIB026"
## [2270] "s__parauberis"
## [2271] "s__campi"
## [2272] "s__sp. R5-89-07"
## [2273] "s__koyamae"
## [2274] "s__casei"
## [2275] "s__sp. MC1865"
## [2276] "s__cacticida"
## [2277] "s__sp. 628"
## [2278] "s__sp. S3-43"
## [2279] "s__sp. T1"
## [2280] "s__acticola"
## [2281] "s__sp. WMMD937"
## [2282] "s__cibarius"
## [2283] "s__pleomorpha"
## [2284] "s__sp. LX10"
## [2285] "s__cynanchi"
## [2286] "s__antarcticum"
## [2287] "s__lushaniae"
## [2288] "s__dendritiformis"
## [2289] "s__iniae"
## [2290] "s__daqingense"
## [2291] "s__ungokensis"
## [2292] "s__noursei"
## [2293] "s__saprophyticus"
## [2294] "s__sp. LH3U1"
## [2295] "s__choerinum"
## [2296] "s__parasitica"
## [2297] "s__sp. 7M"
## [2298] "s__sp. KY5"
## [2299] "s__sp. KGMB00164"
## [2300] "s__gotjawali"
```

```
## [2301] "s__sediminicola"
## [2302] "s__bialowiezensis"
## [2303] "s__zhangjianzhongii"
## [2304] "s__alkalescens"
## [2305] "s__elenkinii"
## [2306] "s__sp. FJAT-18017"
## [2307] "s__sp. N4-1P"
## [2308] "s__syzygii"
## [2309] "s__sp. FARSPH"
## [2310] "s__sp. 769"
## [2311] "s__abundans"
## [2312] "s__sp. DZFXJ 01"
## [2313] "s__smegmatis"
## [2314] "s__qinzhouensis"
## [2315] "s__alboflavus"
## [2316] "s__eligens"
## [2317] "s__goriensis"
## [2318] "s__congregatus"
## [2319] "s__kitaharae"
## [2320] "s__atypicum"
## [2321] "s__oreochromis"
## [2322] "s__phototrophica"
## [2323] "s__sp. JX0631"
## [2324] "s__porticola"
## [2325] "s__communis"
## [2326] "s__grayi"
## [2327] "s__tracheiphila"
## [2328] "s__sp. TJ11"
## [2329] "s__noguchii"
## [2330] "s__subterranea"
## [2331] "s__luteifluviistationis"
## [2332] "s__foliorum"
## [2333] "s__sp. UKPF54-2"
## [2334] "s__madurae"
## [2335] "s__namhicola"
## [2336] "s__rubra"
## [2337] "s__liangguodongii"
## [2338] "s__sp. A15-44"
## [2339] "s__porcinus"
## [2340] "s__badenianii"
## [2341] "s__europaea"
## [2342] "s__sp. L-A4"
## [2343] "s__sp. F-70"
## [2344] "s__sp. HU2014"
## [2345] "s__sp. ID03"
## [2346] "s__hydrocarbonoxydans"
## [2347] "s__jilunlii"
## [2348] "s__sp. G1-14"
## [2349] "s__guizhouensis"
## [2350] "s__magneticus"
## [2351] "s__jeddahense"
## [2352] "s__sp. WD16"
## [2353] "s__corporis"
## [2354] "s__genosp. B"
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## [2355] "s__maritima"
## [2356] "s__heidelbergense"
## [2357] "s__sp. TAC-1"
## [2358] "s__madagascariense"
## [2359] "s__arenosus"
## [2360] "s__sp. cx-173"
## [2361] "s__pneumoniae"
## [2362] "s__sp. TF02-10"
## [2363] "s__sp. A64"
## [2364] "s__yangpuensis"
## [2365] "s__briensis"
## [2366] "s__sp. DL592"
## [2367] "s__sp. BJN0001"
## [2368] "s__sp. JA-2-3B'a(2-13)"
## [2369] "s__toluolica"
## [2370] "s__atrophaeus"
## [2371] "s__sp. IP-1-18"
## [2372] "s__sp. M20"
## [2373] "s__sp. B183"
## [2374] "s__sp. THAF33"
## [2375] "s__sp. CO-6"
## [2376] "s__sp. ATCC 39006"
## [2377] "s__spiralis"
## [2378] "s__sp. SORT26"
## [2379] "s__sp. S171"
## [2380] "s__massiliense"
## [2381] "s__sp. MORI2"
## [2382] "s__oncorhynchi"
## [2383] "s__sp. GU-1"
## [2384] "s__weihaiensis"
## [2385] "s__sp. 200"
## [2386] "s__proteolyticus"
## [2387] "s__sp. CY-G"
## [2388] "s__breoganii"
## [2389] "s__weissii"
## [2390] "s__sp. RLB1-33"
## [2391] "s__vulgare"
## [2392] "s__sp. PET50"
## [2393] "s__formicivorans"
## [2394] "s__verrucosa"
## [2395] "s__oryzihabitans"
## [2396] "s__sp. SSW1-51"
## [2397] "s__oligotrophus"
## [2398] "s__dongxiuzhuiae"
## [2399] "s__sp. MMS21-STM10"
## [2400] "s__sp. DG25A"
## [2401] "s__urinalis"
## [2402] "s__duncaniae"
## [2403] "s__hakodatensis"
## [2404] "s__pseudomesenteroides"
## [2405] "s__sp. I3-3-33"
## [2406] "s__vietnamensis"
## [2407] "s__sp. B-3"
## [2408] "s__sp. HY006"
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## [2409] "s__orientalis"
## [2410] "s__viridosporus"
## [2411] "s__sp. PCC 7367"
## [2412] "s__sp. TGY1127_2"
## [2413] "s__acanthamoebae"
## [2414] "s__friuliensis"
## [2415] "s__sicca"
## [2416] "s__necrophorum"
## [2417] "s__sp. CP102"
## [2418] "s__cellulovorans"
## [2419] "s__kmetyi"
## [2420] "s__endosymbiont of unidentified scaly snail isolate Monju"
## [2421] "s__backii"
## [2422] "s__woodii"
## [2423] "s__septentrionale"
## [2424] "s__sp. M1242"
## [2425] "s__sp. LX-29"
## [2426] "s__sp. SSPM10-3"
## [2427] "s__sp. K90mix"
## [2428] "s__sp. PYR15"
## [2429] "s__forsetii"
## [2430] "s__kribbensis"
## [2431] "s__sp. 905_Psudmo1"
## [2432] "s__sp. YS9"
## [2433] "s__mycoides"
## [2434] "s__merdae"
## [2435] "s__bathyalis"
## [2436] "s__virosa"
## [2437] "s__sp. 4G125"
## [2438] "s__piscicida"
## [2439] "s__sp. L-2-11"
## [2440] "s__gibsoniae"
## [2441] "s__teichomyceticus"
## [2442] "s__sp. DMF-1"
## [2443] "s__plantisponsor"
## [2444] "s__sp. MSMB617WGS"
## [2445] "s__monocytogenes"
## [2446] "s__sp. CFSAN093246"
## [2447] "s__pantothenticus"
## [2448] "s__mucimassa"
## [2449] "s__hibernicus"
## [2450] "s__neteri"
## [2451] "s__phragmitetus"
## [2452] "s__epipsammum"
## [2453] "s__derwentensis"
## [2454] "s__sp. ESL0775"
## [2455] "s__hypogea"
## [2456] "s__ellisii"
## [2457] "s__falsenii"
## [2458] "s__limosum"
## [2459] "s__sp. oral taxon 475"
## [2460] "s__metallidurans"
## [2461] "s__sp. MM213"
## [2462] "s__eucalypticola"
```

```
## [2463] "s__sp. OIL-1"
## [2464] "s__acidoterrestris"
## [2465] "s__gonidiaformans"
## [2466] "s__sp. FWKO B"
## [2467] "s__[Clostridium] innocuum"
## [2468] "s__piscinale"
## [2469] "s__sp. 432"
## [2470] "s__sp. 20-132"
## [2471] "s__sp. JZ18"
## [2472] "s__sp. CCS1"
## [2473] "s__sp. WH 8101"
## [2474] "s__sanarellii"
## [2475] "s__sp. SS-MA-C1-2"
## [2476] "s__sp. RM12651"
## [2477] "s__kanamyceticus"
## [2478] "s__sp. P11G5"
## [2479] "s__xylinus"
## [2480] "s__sp. A10-1-5-1"
## [2481] "s__inopinatus"
## [2482] "s__sp. DG56-2"
## [2483] "s__acidocaldarius"
## [2484] "s__acetylicum"
## [2485] "s__sp. AOP6"
## [2486] "s__compactum"
## [2487] "s__gazogenes"
## [2488] "s__sp. 2447"
## [2489] "s__sp. LUNF3"
## [2490] "s__sp. AMBV1719"
## [2491] "s__arenae"
## [2492] "s__luticellarii"
## [2493] "s__sp. JDR-2"
## [2494] "s__fracticalcis"
## [2495] "s__brenneri"
## [2496] "s__flavithermus"
## [2497] "s__pseudomallei"
## [2498] "s__sp. MYb239"
## [2499] "s__macrogoltabida"
## [2500] "s__sp. SMC-8"
## [2501] "s__sp. 7D3"
## [2502] "s__haemolyticum"
## [2503] "s__sp. KA22"
## [2504] "s__sp. Marseille-Q7826"
## [2505] "s__carnosum"
## [2506] "s__purpureochromogenes"
## [2507] "s__sp. RerS4"
## [2508] "s__multiformis"
## [2509] "s__shinshuensis"
## [2510] "s__nagelii"
## [2511] "s__sp. YC1"
## [2512] "s__sp. A18/5-2"
## [2513] "s__sp. G2-70"
## [2514] "s__fulva"
## [2515] "s__sp. A12"
## [2516] "s__sp. K5869"
```

```
## [2517] "s__suaedae"
## [2518] "s__sp. 09C 129"
## [2519] "s__sp. 103DPR2"
## [2520] "s__sp. StRB126"
## [2521] "s__sp. HL-66"
## [2522] "s__sp. ZM22"
## [2523] "s__sp. XHJ-5"
## [2524] "s__sp. PCC 7336"
## [2525] "s__pretoriensis"
## [2526] "s__seleniipraecipitans"
## [2527] "s__Candidatus Endomicrobium trichonymphae"
## [2528] "s__frederiksbergensis"
## [2529] "s__mucicolens"
## [2530] "s__sp. CS20"
## [2531] "s__subglaciescola"
## [2532] "s__physcomitrellae"
## [2533] "s__capitis"
## [2534] "s__sp. IVB6233"
## [2535] "s__qitaiheensis"
## [2536] "s__sp. ES6"
## [2537] "s__sp. MC19"
## [2538] "s__owensensis"
## [2539] "s__urashimensis"
## [2540] "s__duvalii"
## [2541] "s__syringae"
## [2542] "s__aerogenes"
## [2543] "s__praevalens"
## [2544] "s__zymae"
## [2545] "s__subrutilus"
## [2546] "s__sp. NIES-970"
## [2547] "s__sp. I4-1-79"
## [2548] "s__inositola"
## [2549] "s__ficaria"
## [2550] "s__plantarum"
## [2551] "s__sp. P5"
## [2552] "s__katrae"
## [2553] "s__nicotianae"
## [2554] "s__fragilis"
## [2555] "s__autoethanogenum"
## [2556] "s__ureilytica"
## [2557] "s__salegens"
## [2558] "s__sp. LA31"
## [2559] "s__maricola"
## [2560] "s__sp. NS4"
## [2561] "s__equolifaciens"
## [2562] "s__qomolangmaensis"
## [2563] "s__sp. NSP9.1"
## [2564] "s__sp. HC6"
## [2565] "s__salexigens"
## [2566] "s__sp. AQ5-07"
## [2567] "s__sp. TEGF004"
## [2568] "s__huguangmaarense"
## [2569] "s__benzoatilyticus"
## [2570] "s__qilianensis"
```

```
## [2571] "s__sp. SL130"
## [2572] "s__equi"
## [2573] "s__blasticum"
## [2574] "s__auratinigra"
## [2575] "s__sp. SirexAA-E"
## [2576] "s__butyricum"
## [2577] "s__sp. AP8"
## [2578] "s__crocea"
## [2579] "s__shinjukuense"
## [2580] "s__sp. HN-2-9-2"
## [2581] "s__furentiruminis"
## [2582] "s__natalensis"
## [2583] "s__xanthophaeus"
## [2584] "s__breve"
## [2585] "s__sp. RKMC-009"
## [2586] "s__mirum"
## [2587] "s__sp. WMMD791"
## [2588] "s__pseudocatenulatum"
## [2589] "s__dechloratans"
## [2590] "s__sp. XT11"
## [2591] "s__gummiphilus"
## [2592] "s__lactis"
## [2593] "s__sp. SSBR10-3"
## [2594] "s__[Clostridium] hylemonae"
## [2595] "s__magnusonii"
## [2596] "s__yushuensis"
## [2597] "s__hirae"
## [2598] "s__pratisalsi"
## [2599] "s__acetoxidans"
## [2600] "s__xenovorans"
## [2601] "s__sp. AR07"
## [2602] "s__medium"
## [2603] "s__sp. GF20"
## [2604] "s__sp. SCSIO 76264"
## [2605] "s__gilvum"
## [2606] "s__sp. RHB36-C18"
## [2607] "s__acetobutylicum"
## [2608] "s__epidermidicanis"
## [2609] "s__endosymbiont of Euscepes postfasciatus"
## [2610] "s__resinovorum"
## [2611] "s__fontium"
## [2612] "s__purcellii"
## [2613] "s__sp. NBC_00550"
## [2614] "s__sp. SW4"
## [2615] "s__slithyformis"
## [2616] "s__sp. Ai-910"
## [2617] "s__pecoris"
## [2618] "s__sp. TS-293"
## [2619] "s__phenoliruptrix"
## [2620] "s__soudanensis"
## [2621] "s__sp. FDAARGOS 1405"
## [2622] "s__endosymbiont of 'Nebria riversi'"
## [2623] "s__petrolearium"
## [2624] "s__sp. M4R1S46"
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## [2625] "s__sp. DM-R-R2A-13"
## [2626] "s__sp. H567"
## [2627] "s__sp. AP-Nino-20-G2"
## [2628] "s__asaccharolytica"
## [2629] "s__salinum"
## [2630] "s__meningitidis"
## [2631] "s__sp. IMCC20628"
## [2632] "s__sp. oral taxon 894"
## [2633] "s__genomosp. 8"
## [2634] "s__sp. wcd7"
## [2635] "s__capitiformicae"
## [2636] "s__sp. WMMB 499"
## [2637] "s__cholangitidis"
## [2638] "s__sp. ULC335"
## [2639] "s__meliloti"
## [2640] "s__sp. 5MLIR"
## [2641] "s__sp. NRL 22/194"
## [2642] "s__sp. HDW6C"
## [2643] "s__acidiphilus"
## [2644] "s__sp. Arc7-DN-1"
## [2645] "s__halophytocola"
## [2646] "s__oremlandii"
## [2647] "s__sp. co_0103"
## [2648] "s__intermedius"
## [2649] "s__lentocellum"
## [2650] "s__sp. RBIITD"
## [2651] "s__suwonensis"
## [2652] "s__sp. SFB-mouse"
## [2653] "s__schaedleri"
## [2654] "s__rubneri"
## [2655] "s__carbinolicus"
## [2656] "s__sp. CCOS 191"
## [2657] "s__sp. VKM Ac-2805"
## [2658] "s__arthrosphaerae"
## [2659] "s__sp. X156"
## [2660] "s__sp. MA1X17-3"
## [2661] "s__sp. AQ5-05"
## [2662] "s__agaridevorans"
## [2663] "s__xieshaowenii"
## [2664] "s__barcinonensis"
## [2665] "s__ruthenica"
## [2666] "s__sp. F1-1"
## [2667] "s__fagopyri"
## [2668] "s__mortiferum"
## [2669] "s__sp. CP1"
## [2670] "s__sp. AJ005"
## [2671] "s__xylanilyticus"
## [2672] "s__americanum"
## [2673] "s__salicampi"
## [2674] "s__goeteborgense"
## [2675] "s__sp. SMBL_HHYL_HB1"
## [2676] "s__sp. Nx66"
## [2677] "s__anserum"
## [2678] "s__chenjunshii"
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## [2679] "s__cuniculi"
## [2680] "s__mimicus"
## [2681] "s__spinosum"
## [2682] "s__sp. MYC017"
## [2683] "s__pollutisoli"
## [2684] "s__acidophilus"
## [2685] "s__eucrina"
## [2686] "s__maculosa"
## [2687] "s__sabinae"
## [2688] "s__cardium"
## [2689] "s__anthophila"
## [2690] "s__onobrychidis"
## [2691] "s__citreum"
## [2692] "s__wulumuqiensis"
## [2693] "s__sp. CA-278952"
## [2694] "s__chlororaphis"
## [2695] "s__scatologenes"
## [2696] "s__nematophila"
## [2697] "s__photophilum"
## [2698] "s__polyxenophila"
## [2699] "s__neptuniae"
## [2700] "s__linens"
## [2701] "s__sp. 17J80-10"
## [2702] "s__gilardii"
## [2703] "s__submarina"
## [2704] "s__toyonensis"
## [2705] "s__sp. YJ47"
## [2706] "s__sp. CACC 737"
## [2707] "s__segmentosum"
## [2708] "s__sp. FW306-2-2C-D06B"
## [2709] "s__gladioli"
## [2710] "s__sp. JB2"
## [2711] "s__acidilactici"
## [2712] "s__turnerae"
## [2713] "s__sp. OM-1"
## [2714] "s__sp. NOUM97013"
## [2715] "s__carrageenivorans"
## [2716] "s__kochii"
## [2717] "s__amiense"
## [2718] "s__sp. MIL9"
## [2719] "s__paracasei"
## [2720] "s__sp. NBEC-018"
## [2721] "s__xylanivorans"
## [2722] "s__heckeshornense"
## [2723] "s__cecorum"
## [2724] "s__sp. BG4"
## [2725] "s__sp. Marseille-Q6967"
## [2726] "s__sp. CD3-6"
## [2727] "s__profundus"
## [2728] "s__christensenii"
## [2729] "s__anatis"
## [2730] "s__kristinae"
## [2731] "s__sp. oral taxon 171"
## [2732] "s__fermentum"
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## [2733] "s__glycerini"
## [2734] "s__sp. PC121B"
## [2735] "s__sp. SC05B48"
## [2736] "s__toruni"
## [2737] "s__doricum"
## [2738] "s__sp. FW80"
## [2739] "s__dendranthematis"
## [2740] "s__sp. B3-10"
## [2741] "s__nivalisilvae"
## [2742] "s__calidilacus"
## [2743] "s__sp. LS-1"
## [2744] "s__pratensis"
## [2745] "s__sp. QA3"
## [2746] "s__sp. NS01"
## [2747] "s__reichenbachii"
## [2748] "s__sp. MB5"
## [2749] "s__sp. QT-25"
## [2750] "s__convoluta"
## [2751] "s__perseverans"
## [2752] "s__sp. LK10"
## [2753] "s__sp. Clip185"
## [2754] "s__hydrothermale"
## [2755] "s__sp. F3-2"
## [2756] "s__aphidicola"
## [2757] "s__sp. LHK192"
## [2758] "s__pluranimalium"
## [2759] "s__sp. SC041"
## [2760] "s__felis"
## [2761] "s__fabrum"
## [2762] "s__sp. H8"
## [2763] "s__kalamazoonensis"
## [2764] "s__sulfonivorans"
## [2765] "s__sp. DY-1"
## [2766] "s__sp. YIM 151500-1"
## [2767] "s__bangladeshense"
## [2768] "s__sp. HN38"
## [2769] "s__sp. PM3"
## [2770] "s__parainfluenzae"
## [2771] "s__turfanensis"
## [2772] "s__sp. CB04723"
## [2773] "s__ruminis"
## [2774] "s__sp. HL-2"
## [2775] "s__sp. MS1601"
## [2776] "s__campestris"
## [2777] "s__clavuligerus"
## [2778] "s__forsythia"
## [2779] "s__sp. SCSIO 43206"
## [2780] "s__ihbetae"
## [2781] "s__safensis"
## [2782] "s__baliensis"
## [2783] "s__sp. SMR4y"
## [2784] "s__alvini"
## [2785] "s__sp. N3/727"
## [2786] "s__aurimucosum"
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## [2787] "s__methylovorus"
## [2788] "s__sp. SWBY1"
## [2789] "s__populi"
## [2790] "s__mannitolilytica"
## [2791] "s__sp. GilTou73"
## [2792] "s__sulfoxidireducens"
## [2793] "s__sp. Helios"
## [2794] "s__wardiae"
## [2795] "s__sp. FSL H7-0357"
## [2796] "s__sp. S3"
## [2797] "s__eulemuris"
## [2798] "s__aquiflavi"
## [2799] "s__panacis"
## [2800] "s__timonae"
## [2801] "s__gasicomitatum"
## [2802] "s__sp. 001"
## [2803] "s__mongoliensis"
## [2804] "s__pickeringii"
## [2805] "s__aerolata"
## [2806] "s__amphicarpaeae"
## [2807] "s__alcaliphilus"
## [2808] "s__sp. AC1"
## [2809] "s__choshinensis"
## [2810] "s__boronicumulans"
## [2811] "s__mikurensis"
## [2812] "s__sp. DCY119"
## [2813] "s__shaoxiangyii"
## [2814] "s__sp. AR02"
## [2815] "s__salsuginis"
## [2816] "s__sp. RAC01"
## [2817] "s__aromaticum"
## [2818] "s__suum"
## [2819] "s__balustinum"
## [2820] "s__necessarius"
## [2821] "s__metallireducens"
## [2822] "s__lycopersici"
## [2823] "s__tendae"
## [2824] "s__sp. WDL1"
## [2825] "s__agnetis"
## [2826] "s__ovata"
## [2827] "s__camelliae"
## [2828] "s__vini"
## [2829] "s__sp. SCSIO 65647"
## [2830] "s__acidiphila"
## [2831] "s__biflexa"
## [2832] "s__ureafaciens"
## [2833] "s__parvula"
## [2834] "s__marianensis"
## [2835] "s__catus"
## [2836] "s__rubrifaciens"
## [2837] "s__sp. oral taxon 190"
## [2838] "s__nitrogeniifigens"
## [2839] "s__enterocolitica"
## [2840] "s__sp. R1"
```

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## [2841] "s__helgolandensis"
## [2842] "s__shandongense"
## [2843] "s__trehalosi"
## [2844] "s__vervacti"
## [2845] "s__aerotolerans"
## [2846] "s__rossiae"
## [2847] "s__sp. SL75"
## [2848] "s__plasticadhaerens"
## [2849] "s__iranicus"
## [2850] "s__tasmaniensis"
## [2851] "s__sp. NEB 394"
## [2852] "s__sp. MYC098"
## [2853] "s__xylanolytica"
## [2854] "s__sp. WMMC415"
## [2855] "s__morbillorum"
## [2856] "s__cellulositrophicus"
## [2857] "s__longum"
## [2858] "s__showae"
## [2859] "s__sp. CM027"
## [2860] "s__sp. T1-3-2"
## [2861] "s__riviphilus"
## [2862] "s__trevisanii"
## [2863] "s__sp. DEMB1"
## [2864] "s__balticum"
## [2865] "s__sp. SSHM10-5"
## [2866] "s__guangxiense"
## [2867] "s__subvibrioides"
## [2868] "s__sp. zth1"
## [2869] "s__lagogenitalium"
## [2870] "s__durans"
## [2871] "s__sp. GOM7"
## [2872] "s__occultum"
## [2873] "s__anguillarum"
## [2874] "s__plantarii"
## [2875] "s__sp. DSM 45060"
## [2876] "s__aryabhattai"
## [2877] "s__cyclohexanicum"
## [2878] "s__sp. SCSIO 43205"
## [2879] "s__stylophorae"
## [2880] "s__sangjuense"
## [2881] "s__apodemus"
## [2882] "s__sp. B2-1-1"
## [2883] "s__diminuta"
## [2884] "s__neocaledonicus"
## [2885] "s__thermoamylovorans"
## [2886] "s__sp. COW1"
## [2887] "s__sp. X23"
## [2888] "s__obesiensis"
## [2889] "s__sp. APR13"
## [2890] "s__sp. MM224"
## [2891] "s__lipoferum"
## [2892] "s__auxotrophicus"
## [2893] "s__proavitum"
## [2894] "s__sp. PTS2502"
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## [2895] "s__sp. 'Marine'"
## [2896] "s__sp. PAMC22086"
## [2897] "s__goksoeyrii"
## [2898] "s__marcescens"
## [2899] "s__sp. SYSU D00693"
## [2900] "s__thalassa"
## [2901] "s__odoriferum"
## [2902] "s__apihabitans"
## [2903] "s__sp. SMC-2"
## [2904] "s__sp. KCTC 72723"
## [2905] "s__sp. B30-1"
## [2906] "s__sp. A30-3"
## [2907] "s__sp. M4B.F.Ca.ET.058.02.1.1"
## [2908] "s__secundus"
## [2909] "s__Paradesulfovibrio bizertensis"
## [2910] "s__sp. NicSoilB8"
## [2911] "s__phaeoluteigriseus"
## [2912] "s__sp. SCSIO 80058"
## [2913] "s__saskatchewanense"
## [2914] "s__bispora"
## [2915] "s__winogradskyi"
## [2916] "s__woesei"
## [2917] "s__fontis"
## [2918] "s__alexandrii"
## [2919] "s__crocinum"
## [2920] "s__sp. Marseille-Q7238"
## [2921] "s__ochotonae"
## [2922] "s__sp. ON39_IFM12276"
## [2923] "s__mytili"
## [2924] "s__sp. 11kri321"
## [2925] "s__sp. CGR1"
## [2926] "s__sp. UKPF54"
## [2927] "s__sp. PAMC28395"
## [2928] "s__phthalatica"
## [2929] "s__poae"
## [2930] "s__pseudodiphtheriticum"
## [2931] "s__sp. OF-1"
## [2932] "s__amoris"
## [2933] "s__sp. Gsoil 973"
## [2934] "s__caldilimi"
## [2935] "s__sp. GSB1"
## [2936] "s__pomeroyi"
## [2937] "s__chengniuliangii"
## [2938] "s__pilosicoli"
## [2939] "s__sp. G128"
## [2940] "s__monumenti"
## [2941] "s__sp. Marseille-Q3773"
## [2942] "s__campbellii"
## [2943] "s__ursingii"
## [2944] "s__keratini"
## [2945] "s__sp. CB09001"
## [2946] "s__exile"
## [2947] "s__sp. B6464"
## [2948] "s__violaceum"
```

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## [2949] "s__pylori"
## [2950] "s__sp. PAMC26660"
## [2951] "s__sp. X19"
## [2952] "s__fluvialis"
## [2953] "s__pennivorans"
## [2954] "s__sp. HG01"
## [2955] "s__geofontis"
## [2956] "s__caecimuris"
## [2957] "s__sp. P-10"
## [2958] "s__sp. CA23"
## [2959] "s__albidoflavus"
## [2960] "s__sp. XF203"
## [2961] "s__wittichii"
## [2962] "s__pentaromativorans"
## [2963] "s__hawaiiensis"
## [2964] "s__turbinis"
## [2965] "s__schindleri"
## [2966] "s__sp. 46C-IIa"
## [2967] "s__incarnatus"
## [2968] "s__sp. 86"
## [2969] "s__mccartyi"
## [2970] "s__sp. W7.2"
## [2971] "s__sciuri"
## [2972] "s__simiae"
## [2973] "s__prausnitzii"
## [2974] "s__fengjieae"
## [2975] "s__edaphicus"
## [2976] "s__sp. TC"
## [2977] "s__sp. SC2"
## [2978] "s__succinatutens"
## [2979] "s__hormaechei"
## [2980] "s__tanaceti"
## [2981] "s__sp. XM-1"
## [2982] "s__sp. NP247"
## [2983] "s__bereziniae"
## [2984] "s__sp. M1B.F.Ca.ET.045.04.1.1"
## [2985] "s__maltaromaticum"
## [2986] "s__sp. X9"
## [2987] "s__reuteri"
## [2988] "s__palmilytica"
## [2989] "s__sp. WKF15"
## [2990] "s__cernigliae"
## [2991] "s__sp. A1C1"
## [2992] "s__tumefaciens"
## [2993] "s__boydii"
## [2994] "s__sp. B3.7"
## [2995] "s__detoxificans"
## [2996] "s__parviboronicapiens"
## [2997] "s__sp. HSL-3221"
## [2998] "s__sp. PG104"
## [2999] "s__feriruminatoris"
## [3000] "s__sp. HP-A2021"
## [3001] "s__busanensis"
## [3002] "s__caenitepidi"
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## [3003] "s__sediminilitoris"
## [3004] "s__wadsworthensis"
## [3005] "s__vaviloviae"
## [3006] "s__sp. CB2312"
## [3007] "s__alcalifaciens"
## [3008] "s__sp. NLF-7-7"
## [3009] "s__defragrans"
## [3010] "s__malonaticus"
## [3011] "s__propionica"
## [3012] "s__mucosalis"
## [3013] "s__sp. ESL0798"
## [3014] "s__sp. CYM-20-01"
## [3015] "s__velezensis"
## [3016] "s__farmeri"
## [3017] "s__currus"
## [3018] "s__sp. INDO-MA30-4"
## [3019] "s__sp. ST13-2-2"
## [3020] "s__sp. 1018B"
## [3021] "s__sp. ESL0764"
## [3022] "s__sp. Caat 7-52"
## [3023] "s__stellifer"
## [3024] "s__mucosus"
## [3025] "s__mali"
## [3026] "s__sp. 169"
## [3027] "s__sp. LPB0319"
## [3028] "s__ammonificans"
## [3029] "s__yonginensis"
## [3030] "s__equigenitalis"
## [3031] "s__sp. 'Moss Beach'"
## [3032] "s__sp. TLY01"
## [3033] "s__sp. L3-i22"
## [3034] "s__sp. WG5"
## [3035] "s__weihenstephanensis"
## [3036] "s__molluscorum"
## [3037] "s__sp. NS3"
## [3038] "s__sp. HA"
## [3039] "s__sp. CCB_US3_UF1"
## [3040] "s__urolithinfaciens"
## [3041] "s__aetherius"
## [3042] "s__colletis"
## [3043] "s__sp. PCC 7117"
## [3044] "s__oligotrophica"
## [3045] "s__diphtheriae"
## [3046] "s__formicae"
## [3047] "s__oryzisoli"
## [3048] "s__sp. CU5"
## [3049] "s__sp. USM3"
## [3050] "s__morelensis"
## [3051] "s__comscasis"
## [3052] "s__sp. WMMA2032"
## [3053] "s__aurantia"
## [3054] "s__sp. DAIF2"
## [3055] "s__thermocatenulatus"
## [3056] "s__tsutsugamushi"
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## [3057] "s__sp. INWT7"
## [3058] "s__aurantiaca"
## [3059] "s__sp. CCBAU 53351"
## [3060] "s__sp. ADI95-16"
## [3061] "s__sp. TBR-22"
## [3062] "s__elegans"
## [3063] "s__sp. 114"
## [3064] "s__humidisoli"
## [3065] "s__sp. M62/1"
## [3066] "s__carbonacea"
## [3067] "s__socranskii"
## [3068] "s__sp. 1(2017)"
## [3069] "s__sp. A1-2"
## [3070] "s__spadix"
## [3071] "s__sp. QA11"
## [3072] "s__sp. FERM BP-3421"
## [3073] "s__baumannii"
## [3074] "s__sp. WMMD1076"
## [3075] "s__sp. BMJM1"
## [3076] "s__[Ruminococcus] gnavus"
## [3077] "s__tianjinensis"
## [3078] "s__freudenreichii"
## [3079] "s__vitulinus"
## [3080] "s__sp. CB82"
## [3081] "s__sp. GBBC 1281"
## [3082] "s__sp. JY-23"
## [3083] "s__hiberniae"
## [3084] "s__sp. MC1572"
## [3085] "s__sullae"
## [3086] "s__lactatifermentans"
## [3087] "s__sp. PAMC 28766"
## [3088] "s__zhangwenhongii"
## [3089] "s__sp. N3-W"
## [3090] "s__sp. ND 6198"
## [3091] "s__meiyuanensis"
## [3092] "s__sp. SL55"
## [3093] "s__sp. DY30"
## [3094] "s__sp. S13-6-22"
## [3095] "s__helcogenes"
## [3096] "s__sp. DSM 110487"
## [3097] "s__sp. SGAir0253"
## [3098] "s__sp. ALD11"
## [3099] "s__amnicola"
## [3100] "s__fluorescens"
## [3101] "s__poriferae"
## [3102] "s__algifaecis"
## [3103] "s__lienomycini"
## [3104] "s__fuscus"
## [3105] "s__pallidum"
## [3106] "s__umeaense"
## [3107] "s__termitidis"
## [3108] "s__sp. B21-035"
## [3109] "s__rubrisubalbicans"
## [3110] "s__tabanidicola"
```

```
## [3111] "s__sp. SGAir0095"
## [3112] "s__herbifermentans"
## [3113] "s__fontanus"
## [3114] "s__sanxanigenens"
## [3115] "s__sp. SUN039"
## [3116] "s__anomalus"
## [3117] "s__hejianensis"
## [3118] "s__sp. OMZ 857"
## [3119] "s__phaeobacteroides"
## [3120] "s__dorei"
## [3121] "s__heilongjiangensis"
## [3122] "s__monsensis"
## [3123] "s__badius"
## [3124] "s__sp. L3A6"
## [3125] "s__neptunia"
## [3126] "s__sp. KUDC1714"
## [3127] "s__sp. Marseille-Q4132"
## [3128] "s__sp. TSH100"
## [3129] "s__neptunium"
## [3130] "s__mishustinae"
## [3131] "s__sp. P02-A3a"
## [3132] "s__sulfodismutans"
## [3133] "s__sp. A16"
## [3134] "s__chungangensis"
## [3135] "s__anginosus"
## [3136] "s__acidifaciens"
## [3137] "s__sp. ZJ932"
## [3138] "s__equuli"
## [3139] "s__hydrogenoformans"
## [3140] "s__cyanogenus"
## [3141] "s__salitolerans"
## [3142] "s__sulfurreducens"
## [3143] "s__pseudoporcinus"
## [3144] "s__sp. L-07"
## [3145] "s__aestuarium"
## [3146] "s__hongdechloris"
## [3147] "s__aciditrophicus"
## [3148] "s__cohnii"
## [3149] "s__necropolis"
## [3150] "s__xenopi"
## [3151] "s__monobiae"
## [3152] "s__sp. EFPC1"
## [3153] "s__alimapuensis"
## [3154] "s__sp. T808"
## [3155] "s__dynata"
## [3156] "s__sojae"
## [3157] "s__sp. SCSIO 43195"
## [3158] "s__modestum"
## [3159] "s__capeferrum"
## [3160] "s__paeninsulae"
## [3161] "s__sp. TCU-HL1"
## [3162] "s__volantium"
## [3163] "s__sp. C56-T3"
## [3164] "s__vaginae"
```

```
## [3165] "s__cellulolyticus"
## [3166] "s__asymbiotica"
## [3167] "s__sp. E9-3"
## [3168] "s__sp. CX-624"
## [3169] "s__gasigenes"
## [3170] "s__histolytica"
## [3171] "s__asgharzadehiana"
## [3172] "s__sp. TRM90804"
## [3173] "s__sp. P6-10-X1"
## [3174] "s__sphenisci"
## [3175] "s__fumaroxidans"
## [3176] "s__sp. CA-258035"
## [3177] "s__yanoikuyae"
## [3178] "s__houyundeii"
## [3179] "s__gallaeciensis"
## [3180] "s__kullabergensis"
## [3181] "s__murdochii"
## [3182] "s__sp. CL5.1"
## [3183] "s__nasdae"
## [3184] "s__enclensis"
## [3185] "s__[Pseudomonas] carboxydohydrogena"
## [3186] "s__sp. RSCCF101"
## [3187] "s__sp. Dwa41.01b"
## [3188] "s__proteolyticum"
## [3189] "s__sp. JS623"
## [3190] "s__sp. M523"
## [3191] "s__raichei"
## [3192] "s__sp. WA1-19"
## [3193] "s__roggenkampii"
## [3194] "s__esteraromaticum"
## [3195] "s__ferrugineus"
## [3196] "s__sp. PBTS 1"
## [3197] "s__sp. SYP-B4298"
## [3198] "s__gergoviae"
## [3199] "s__sp. QH-2"
## [3200] "s__sp. 140616W15"
## [3201] "s__sp. HDW3"
## [3202] "s__sp. Kera G14"
## [3203] "s__procaprae"
## [3204] "s__sp. CFWR-12"
## [3205] "s__nepalensis"
## [3206] "s__loti"
## [3207] "s__sp. WY2"
## [3208] "s__sulfidiphilus"
## [3209] "s__saidenbachensis"
## [3210] "s__hundungensis"
## [3211] "s__sp. SOG26"
## [3212] "s__sp. S30A1"
## [3213] "s__sp. HDW8"
## [3214] "s__olivoreticuli"
## [3215] "s__sp. WMMD712"
## [3216] "s__chilikensis"
## [3217] "s__sp. HSL1-3"
## [3218] "s__photometricum"
```

```
## [3219] "s__cauae"
## [3220] "s__tusciae"
## [3221] "s__wadei"
## [3222] "s__bongori"
## [3223] "s__aponinum"
## [3224] "s__paracollinoides"
## [3225] "s__cylindroides"
## [3226] "s__cremeum"
## [3227] "s__varium"
## [3228] "s__psychrosaccharolyticus"
## [3229] "s__flavigena"
## [3230] "s__sp. IT6"
## [3231] "s__salyersiae"
## [3232] "s__pittii"
## [3233] "s__viridescens"
## [3234] "s__caviae"
## [3235] "s__sp. 186"
## [3236] "s__sp. oral taxon 498"
## [3237] "s__sp. NHF165"
## [3238] "s__sp. SCSIO 12839"
## [3239] "s__tyrobutyricum"
## [3240] "s__butyrica"
## [3241] "s__kisseleviana"
## [3242] "s__diazotrophica"
## [3243] "s__sulfidivorans"
## [3244] "s__sp. JB150"
## [3245] "s__sp. HUAS 14-6"
## [3246] "s__paralicheniformis"
## [3247] "s__sp. NMCR1094"
## [3248] "s__sp. B4-1-4"
## [3249] "s__sp. 15R"
## [3250] "s__sp. WMMA1976"
## [3251] "s__wangjianweii"
## [3252] "s__Candidatus Promineofilum breve"
## [3253] "s__virginiensis"
## [3254] "s__thiaminolyticus"
## [3255] "s__sp. HDW4B"
## [3256] "s__vestitus"
## [3257] "s__cycloheptanicus"
## [3258] "s__acidaminophilum"
## [3259] "s__oceanibius"
## [3260] "s__coprosuis"
## [3261] "s__sp. GMY02"
## [3262] "s__nigrificans"
## [3263] "s__sp. YA7-1"
## [3264] "s__thalassium"
## [3265] "s__sp. FSL R5-0345"
## [3266] "s__cookii"
## [3267] "s__haloalkaliphila"
## [3268] "s__pinisoli"
## [3269] "s__sp. ESL0680"
## [3270] "s__viscosus"
## [3271] "s__sp. CBW1004"
## [3272] "s__sp. CDRTa11"
```

```
## [3273] "s__sp. Pen4"
## [3274] "s__foraminis"
## [3275] "s__gelatinilytica"
## [3276] "s__globosa"
## [3277] "s__crustorum"
## [3278] "s__phycosphaerae"
## [3279] "s__sp. HY158"
## [3280] "s__cochlearium"
## [3281] "s__sp. SCHIC003"
## [3282] "s__provencense"
## [3283] "s__yellowstonii"
## [3284] "s__fluminis"
## [3285] "s__sp. GJ3"
## [3286] "s__icense"
## [3287] "s__marmotae"
## [3288] "s__xerosis"
## [3289] "s__buchneri"
## [3290] "s__albicereus"
## [3291] "s__sp. B11"
## [3292] "s__nanhainus"
## [3293] "s__lacuslunae"
## [3294] "s__thiosulfatoxidans"
## [3295] "s__sp. SMC90"
## [3296] "s__dysenteriae"
## [3297] "s__primitia"
## [3298] "s__retbaense"
## [3299] "s__sp. YIK13"
## [3300] "s__sp. THAF5a"
## [3301] "s__dumasiana"
## [3302] "s__sp. M8A.F.Ca.ET.057.01.1.1"
## [3303] "s__guillouiae"
## [3304] "s__sp. H17E-10"
## [3305] "s__sp. NIES-3755"
## [3306] "s__sp. 195"
## [3307] "s__sp. PROV188"
## [3308] "s__sp. Mc7"
## [3309] "s__sp. XES5"
## [3310] "s__organophilum"
## [3311] "s__sp. Kuro-4"
## [3312] "s__perfilievii"
## [3313] "s__estertheticum"
## [3314] "s__sp. MUD11"
## [3315] "s__cuniculorum"
## [3316] "s__longicatena"
## [3317] "s__autotrophicus"
## [3318] "s__sp. MT58"
## [3319] "s__sp. AB-CW3"
## [3320] "s__azotonutricia"
## [3321] "s__cattleyae"
## [3322] "s__sp. EJY3"
## [3323] "s__innesii"
## [3324] "s__sp. ERMR1:05"
## [3325] "s__sp. YLGW01"
## [3326] "s__aeolicus"
```

```
## [3327] "s__porphyridii"
## [3328] "s__sp. WY4"
## [3329] "s__chipingensis"
## [3330] "s__beringensis"
## [3331] "s__sp. LM 6"
## [3332] "s__uniformis"
## [3333] "s__obeum"
## [3334] "s__animaloris"
## [3335] "s__davaonensis"
## [3336] "s__sp. B2-8-5"
## [3337] "s__sp. CS2"
## [3338] "s__agglomerans"
## [3339] "s__sp. ORNL1"
## [3340] "s__macerans"
## [3341] "s__sp. KACC 23027"
## [3342] "s__hydrogeniformans"
## [3343] "s__phocae"
## [3344] "s__sp. PRF04-17"
## [3345] "s__sp. PAMC20947"
## [3346] "s__poyangense"
## [3347] "s__Verrucosispora sp. NA02020"
## [3348] "s__sp. GQFP"
## [3349] "s__odontotermitis"
## [3350] "s__cucumeris"
## [3351] "s__sp. CA-230715"
## [3352] "s__sp. ZJ70"
## [3353] "s__sp. TKS"
## [3354] "s__Candidatus Sulfurimonas baltica"
## [3355] "s__sp. YMD61"
## [3356] "s__coxensis"
## [3357] "s__sp. ESL0728"
## [3358] "s__odorifer"
## [3359] "s__sp. MT41"
## [3360] "s__vagans"
## [3361] "s__comes"
## [3362] "s__campinensis"
## [3363] "s__pseudococcoides"
## [3364] "s__sp. SZ-19"
## [3365] "s__sp. ZJ785"
## [3366] "s__quintana"
## [3367] "s__sulfuriphilus"
## [3368] "s__aerophila"
## [3369] "s__montiporae"
## [3370] "s__zucineum"
## [3371] "s__suantsaii"
## [3372] "s__parahaemolyticus"
## [3373] "s__rosettiformans"
## [3374] "s__sp. DL440"
## [3375] "s__sp. CJ11"
## [3376] "s__maltophilia"
## [3377] "s__iterans"
## [3378] "s__granulosum"
## [3379] "s__sp. N3-2A"
## [3380] "s__sp. cx-55"
```

```
## [3381] "s__sp. MC1750"
## [3382] "s__sp. T1293"
## [3383] "s__endophyticum"
## [3384] "s__sp. MCCC 1A13316"
## [3385] "s__sp. USMAA2-4"
## [3386] "s__salanitronis"
## [3387] "s__sp. SB3-54"
## [3388] "s__boenickei"
## [3389] "s__linckia"
## [3390] "s__ramosa"
## [3391] "s__chelonae"
## [3392] "s__siphonis"
## [3393] "s__goldsteinii"
## [3394] "s__sp. 9"
## [3395] "s__sp. s12"
## [3396] "s__humanifaecis"
## [3397] "s__sp. NA06056"
## [3398] "s__sp. WUR7"
## [3399] "s__sp. 21P"
## [3400] "s__sp. SS"
## [3401] "s__anulatus"
## [3402] "s__fandaimingii"
## [3403] "s__insubricum"
## [3404] "s__thermosphaericus"
## [3405] "s__citreus"
## [3406] "s__luporum"
## [3407] "s__sp. 2003-09-23"
## [3408] "s__sp. MSP4-1"
## [3409] "s__sp. PAMC 26642"
## [3410] "s__fibrisolvens"
## [3411] "s__sp. ZY-1-1"
## [3412] "s__sp. CBA3605"
## [3413] "s__shimadae"
## [3414] "s__culicicola"
## [3415] "s__sanfranciscensis"
## [3416] "s__sp. FSL R7-0273"
## [3417] "s__sp. CA1"
## [3418] "s__sp. JXN-3"
## [3419] "s__widdelii"
## [3420] "s__majanohamensis"
## [3421] "s__sp. CAA11"
## [3422] "s__multiresinivorans"
## [3423] "s__sp. JL08"
## [3424] "s__sp. SGAir0471"
## [3425] "s__aegosomaticola"
## [3426] "s__durmitorensis"
## [3427] "s__avellanae"
## [3428] "s__sp. PM5"
## [3429] "s__sp. IVB6181"
## [3430] "s__basilensis"
## [3431] "s__sp. BIOS-E4-1"
## [3432] "s__trematum"
## [3433] "s__methanica"
## [3434] "s__sp. ES-001"
```

```
## [3435] "s__sp. Ejp617"
## [3436] "s__hindlerae"
## [3437] "s__sp. PLM2"
## [3438] "s__saigonensis"
## [3439] "s__distasonis"
## [3440] "s__sp. 007"
## [3441] "s__lundensis"
## [3442] "s__ivorii"
## [3443] "s__sp. NE5"
## [3444] "s__sp. PAMC28666"
## [3445] "s__gregarius"
## [3446] "s__sp. X514"
## [3447] "s__granuli"
## [3448] "s__sp. BRD128"
## [3449] "s__lenghuensis"
## [3450] "s__oecophyllae"
## [3451] "s__sp. DNDY-54"
## [3452] "s__Rickettsiales endosymbiont of Stachyamoeba lipophora"
## [3453] "s__grimontii"
## [3454] "s__pauculus"
## [3455] "s__sp. L3A3"
## [3456] "s__crinochetorum"
## [3457] "s__sp. ZJ-18"
## [3458] "s__pusense"
## [3459] "s__sp. MAS-1"
## [3460] "s__sp. CAU 1644"
## [3461] "s__gallinacea"
## [3462] "s__sp. TF1N1"
## [3463] "s__imperatoris"
## [3464] "s__piscifermentans"
## [3465] "s__sp. AK164"
## [3466] "s__Verrucosispora sp. WMMC514"
## [3467] "s__jandaei"
## [3468] "s__sp. F-323"
## [3469] "s__sp. Te-1"
## [3470] "s__halobius"
## [3471] "s__primoryensis"
## [3472] "s__congonensis"
## [3473] "s__raffinosus"
## [3474] "s__methanolivorans"
## [3475] "s__sp. Y33R10-2"
## [3476] "s__chromatireducens"
## [3477] "s__[Enterobacter] lignolyticus"
## [3478] "s__hungatei"
## [3479] "s__genitalium"
## [3480] "s__edwinii"
## [3481] "s__sp. oral taxon 368"
## [3482] "s__hwajinpoensis"
## [3483] "s__sp. I09"
## [3484] "s__sp. OMA3-2"
## [3485] "s__sp. IP-3-29"
## [3486] "s__radiovictrix"
## [3487] "s__sp. ACO-34A"
## [3488] "s__glomerans"
```

```
## [3489] "s__thailandica"
## [3490] "s__sp. MA9"
## [3491] "s__sp. WQ 127309"
## [3492] "s__oshimai"
## [3493] "s__sp. TWE2"
## [3494] "s__singularis"
## [3495] "s__venetianus"
## [3496] "s__sp. 16-5"
## [3497] "s__thermosaccharolyticum"
## [3498] "s__paralimentarius"
## [3499] "s__donghaensis"
## [3500] "s__hydrolyticum"
## [3501] "s__sp. BR1-192"
## [3502] "s__sp. MSH1"
## [3503] "s__arlettae"
## [3504] "s__molinativorax"
## [3505] "s__naeslundii"
## [3506] "s__sp. YPW6"
## [3507] "s__sp. NIBR 02145"
## [3508] "s__seriolae"
## [3509] "s__clostridioformis"
## [3510] "s__sp. QWL-01"
## [3511] "s__wutianyii"
## [3512] "s__volcania"
## [3513] "s__sp. SH-1"
## [3514] "s__sp. HN8-3"
## [3515] "s__sp. Cs-700"
## [3516] "s__stenotrophicus"
## [3517] "s__vinosum"
## [3518] "s__turicensis"
## [3519] "s__ciceri"
## [3520] "s__matruchotii"
## [3521] "s__curtisii"
## [3522] "s__sp. SAORIC-580"
## [3523] "s__dhakensis"
## [3524] "s__saccharolyticus"
## [3525] "s__paraplantarum"
## [3526] "s__epidermidis"
## [3527] "s__aptenodytis"
## [3528] "s__sp. PAMC25564"
## [3529] "s__sp. MF30-B"
## [3530] "s__meridiana"
## [3531] "s__chejuensis"
## [3532] "s__polyisoprenivorans"
## [3533] "s__crudilactis"
## [3534] "s__atrocyanea"
## [3535] "s__caldarium"
## [3536] "s__piger"
## [3537] "s__pondensis"
## [3538] "s__sp. T173"
## [3539] "s__asburiae"
## [3540] "s__sp. WKF20"
## [3541] "s__sp. HC52"
## [3542] "s__sp. SCSIO 43702"
```

```
## [3543] "s__manganicus"
## [3544] "s__kalidii"
## [3545] "s__sp. VN1"
## [3546] "s__sp. KD337-16"
## [3547] "s__hepaticus"
## [3548] "s__formicexedens"
## [3549] "s__symbiotica"
## [3550] "s__sp. VF16"
## [3551] "s__depolymerans"
## [3552] "s__myrionectae"
## [3553] "s__smithii"
## [3554] "s__knackmussii"
## [3555] "s__sp. PAMC22021"
## [3556] "s__flava (ex Peng et al. 2021)"
## [3557] "s__glauca"
## [3558] "s__zhongnanshanii"
## [3559] "s__sp. HNA39"
## [3560] "s__werkmanii"
## [3561] "s__cellulosum"
## [3562] "s__sp. IHB B 17019"
## [3563] "s__halophilum"
## [3564] "s__sp. EAS-AB2608"
## [3565] "s__sp. NH-16"
## [3566] "s__sp. YIM 151858-1"
## [3567] "s__sp. ZJ1417"
## [3568] "s__mucidolens"
## [3569] "s__sphagniphila"
## [3570] "s__dieselolei"
## [3571] "s__creatinolyticus"
## [3572] "s__woodyi"
## [3573] "s__parvus"
## [3574] "s__petrolei"
## [3575] "s__sp. Tu 2975"
## [3576] "s__sp. 6(2017)"
## [3577] "s__lutaonensis"
## [3578] "s__archaeovorus"
## [3579] "s__sp. IVB6238"
## [3580] "s__sp. BSs20148"
## [3581] "s__neoaurum"
## [3582] "s__sp. T8"
## [3583] "s__alocis"
## [3584] "s__narathiwatensis"
## [3585] "s__saanensis"
## [3586] "s__sp. HY1793"
## [3587] "s__marisflavi"
## [3588] "s__putidum"
## [3589] "s__sp. S4-F44"
## [3590] "s__methylohalidivorans"
## [3591] "s__globosus"
## [3592] "s__sp. c-25"
## [3593] "s__sp. ESL0684"
## [3594] "s__sp. PCC 7418"
## [3595] "s__sp. W003"
## [3596] "s__saccharolytica"
```

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## [3597] "s__tataouinensis"
## [3598] "s__sp. AP-Ainpum-60-G11"
## [3599] "s__bogorovii"
## [3600] "s__sp. TH2"
## [3601] "s__koreense"
## [3602] "s__sp. XS-30"
## [3603] "s__subtile"
## [3604] "s__psychroresistens"
## [3605] "s__sp. PAMC21692"
## [3606] "s__daecheongense"
## [3607] "s__sp. SCA2728.1_7"
## [3608] "s__akesuensis"
## [3609] "s__magneticum"
## [3610] "s__lacrimiformis"
## [3611] "s__beimenensis"
## [3612] "s__bugandensis"
## [3613] "s__canettii"
## [3614] "s__porcorum"
## [3615] "s__dankookensis"
## [3616] "s__cepacia"
## [3617] "s__echinofusca"
## [3618] "s__sp. Hca4"
## [3619] "s__pseudamarae"
## [3620] "s__soli (ex Cha et al. 2016)"
## [3621] "s__sp. VG12"
## [3622] "s__sp. JNUCC-31"
## [3623] "s__sp. Alg239-R112"
## [3624] "s__acidipropionici"
## [3625] "s__uterequi"
## [3626] "s__sonnei"
## [3627] "s__sp. 1NLA3E"
## [3628] "s__nivis"
## [3629] "s__tumorigenes"
## [3630] "s__corydidari"
## [3631] "s__ananatis"
## [3632] "s__dentalis"
## [3633] "s__pseudomycoides"
## [3634] "s__sagamiharensis"
## [3635] "s__sp. Rer75"
## [3636] "s__sp. PSE14"
## [3637] "s__sp. MM227"
## [3638] "s__farciminis"
## [3639] "s__nuda"
## [3640] "s__molare"
## [3641] "s__sp. BRD67"
## [3642] "s__luteum"
## [3643] "s__sakazakii"
## [3644] "s__saccharoperbutylacetonicum"
## [3645] "s__sp. DR822"
## [3646] "s__sp. GC21"
## [3647] "s__macedonicus"
## [3648] "s__prasinus"
## [3649] "s__denticolens"
## [3650] "s__sp. 3-20A1M"
```

```
## [3651] "s__efficiens"
## [3652] "s__seriolicida"
## [3653] "s__sp. S2-65"
## [3654] "s__orale"
## [3655] "s__ishizawai"
## [3656] "s__numidicum"
## [3657] "s__sp. PHM005"
## [3658] "s__spanius"
## [3659] "s__sp. BTAi1"
## [3660] "s__cancerogenus"
## [3661] "s__dubius"
## [3662] "s__sp. LMS39"
## [3663] "s__excentricus"
## [3664] "s__rogosae"
## [3665] "s__humosa"
## [3666] "s__sp. S22"
## [3667] "s__sp. R2A3"
## [3668] "s__magnum"
## [3669] "s__enzymogenes"
## [3670] "s__histicola"
## [3671] "s__sp. Ery5"
## [3672] "s__sp. L5B5"
## [3673] "s__bicirculans"
## [3674] "s__amycolatum"
## [3675] "s__sp. GD1P12"
## [3676] "s__halodenitrificans"
## [3677] "s__joostei"
## [3678] "s__sp. M0911"
## [3679] "s__vitaeruminis"
## [3680] "s__[Clostridium] scindens"
## [3681] "s__howellii"
## [3682] "s__sp. LB1"
## [3683] "s__sp. oral taxon 416"
## [3684] "s__sp. E222"
## [3685] "s__sp. 693-2"
## [3686] "s__sp. KORDI-100"
## [3687] "s__euniceicola"
## [3688] "s__taiwanense"
## [3689] "s__sp. YPG26"
## [3690] "s__capsulatum"
## [3691] "s__morindae"
## [3692] "s__sp. DHOD12"
## [3693] "s__ureilyticus"
## [3694] "s__xiamenensis"
## [3695] "s__argentinensis"
## [3696] "s__zamorensis"
## [3697] "s__serinivorans"
## [3698] "s__equipercicus"
## [3699] "s__sp. THAF38"
## [3700] "s__sp. SOD02"
## [3701] "s__sp. R5-41"
## [3702] "s__sp. BP5-C20A"
## [3703] "s__naozhouensis"
## [3704] "s__ochraceum"
```

```
## [3705] "s__sp. B510"
## [3706] "s__santarosai"
## [3707] "s__sp. GRR-S6-38"
## [3708] "s__sp. BALOs_7"
## [3709] "s__sp. BL0902"
## [3710] "s__sp. NMS14P"
## [3711] "s__fructivorans"
## [3712] "s__sp. CV7422"
## [3713] "s__obsidiansis"
## [3714] "s__trichosporium"
## [3715] "s__pasteuri"
## [3716] "s__trachydisci"
## [3717] "s__sp. ASG 101"
## [3718] "s__hollisae"
## [3719] "s__sp. HSf4"
## [3720] "s__hanseatica"
## [3721] "s__thermosphacta"
## [3722] "s__lincolnensis"
## [3723] "s__sp. KPN54798"
## [3724] "s__cucurbitae"
## [3725] "s__sp. MFA1 R4"
## [3726] "s__sp. At-9b"
## [3727] "s__sarraceniae"
## [3728] "s__mageritense"
## [3729] "s__pullorum"
## [3730] "s__sp. AEP1-3"
## [3731] "s__sp. BT-65"
## [3732] "s__ferrivorans"
## [3733] "s__sp. SR38"
## [3734] "s__succinatiphilus"
## [3735] "s__sp. NCPPB 3576"
## [3736] "s__minuta"
## [3737] "s__sp. GO-4"
## [3738] "s__durus"
## [3739] "s__fungorum"
## [3740] "s__sp. 5GHs7-4"
## [3741] "s__sp. GSA-30"
## [3742] "s__saponilacus"
## [3743] "s__sp. 8C15b"
## [3744] "s__ramosus"
## [3745] "s__herdmanii"
## [3746] "s__universalis"
## [3747] "s__basiliense"
## [3748] "s__frumenti"
## [3749] "s__sp. A2-16"
## [3750] "s__sp. str. 'China'"
## [3751] "s__elsdenii"
## [3752] "s__sp. P3"
## [3753] "s__alkaniclasticus"
## [3754] "s__oestradiolicum"
## [3755] "s__petrii"
## [3756] "s__sp. W0125-5"
## [3757] "s__sp. THAF9"
## [3758] "s__indologenes"
```

```
## [3759] "s__hamburgensis"
## [3760] "s__caerulea"
## [3761] "s__sp. MIZ03"
## [3762] "s__sp. SALV-R1"
## [3763] "s__sp. KNU-23"
## [3764] "s__sp. LIG4"
## [3765] "s__litopenaei"
## [3766] "s__sp. MEBOG07"
## [3767] "s__pactum"
## [3768] "s__mesophila"
## [3769] "s__sp. JS614"
## [3770] "s__pallidus"
## [3771] "s__clariflavus"
## [3772] "s__wadsworthii"
## [3773] "s__wuianus"
## [3774] "s__cardiffensis"
## [3775] "s__gracile"
## [3776] "s__wallacei"
## [3777] "s__sp. oral taxon 299"
## [3778] "s__sp. HUAS 13-4"
## [3779] "s__sp. DN3"
## [3780] "s__kyphosi"
## [3781] "s__hankookensis"
## [3782] "s__krabiensis"
## [3783] "s__labii"
## [3784] "s__sp. A29-2"
## [3785] "s__sp. NH8B"
## [3786] "s__sp. FU40"
## [3787] "s__sp. NBH84"
## [3788] "s__spectabilis"
## [3789] "s__sp. FDAARGOS_727"
## [3790] "s__sp. DSM 110486"
## [3791] "s__sp. D12"
## [3792] "s__sp. FDAARGOS 1242"
## [3793] "s__viridiflava"
## [3794] "s__sp. NHP19-012"
## [3795] "s__pseudohinzii"
## [3796] "s__slackii"
## [3797] "s__sp. YJN-G"
## [3798] "s__dongkuii"
## [3799] "s__cerebrosus"
## [3800] "s__lienii"
## [3801] "s__terpenotabidum"
## [3802] "s__sp. phDV1"
## [3803] "s__sp. Go40/10"
## [3804] "s__incognita"
## [3805] "s__sp. URMO17WK12:I11"
## [3806] "s__conchae"
## [3807] "s__sp. MST-110588"
## [3808] "s__rhinotracheale"
## [3809] "s__ginsengisoli An et al. 2013"
## [3810] "s__acidiformans"
## [3811] "s__terminaliae"
## [3812] "s__hengshuiensis"
```

```
## [3813] "s__tropicalis"
## [3814] "s__sp. 0141_2"
## [3815] "s__sp. YY7918"
## [3816] "s__vibrioides"
## [3817] "s__smaragdinae"
## [3818] "s__adolescentis"
## [3819] "s__translucens"
## [3820] "s__sp. Psy1"
## [3821] "s__griseoviridis"
## [3822] "s__rubripertincta"
## [3823] "s__sp. MA3_2.13"
## [3824] "s__echinaurantiaca"
## [3825] "s__sp. C49"
## [3826] "s__sp. NR2"
## [3827] "s__laterosporus"
## [3828] "s__sinipercae"
## [3829] "s__bisphenolicum"
## [3830] "s__sp. Je 1-369"
## [3831] "s__victoriana"
## [3832] "s__sp. TNS106"
## [3833] "s__sp. PAMC25264"
## [3834] "s__phosphorivorans"
## [3835] "s__pamelaeae"
## [3836] "s__sp. IHB B 3084"
## [3837] "s__sp. 21OH12SH02B-Prov"
## [3838] "s__restricta"
## [3839] "s__sp. BSL-9"
## [3840] "s__sp. G4"
## [3841] "s__nanhaiensis"
## [3842] "s__sp. HL-111"
## [3843] "s__sp. B006"
## [3844] "s__pratense"
## [3845] "s__schubertii"
## [3846] "s__sp. DY2415"
## [3847] "s__sp. SH-PL62"
## [3848] "s__rhododendri"
## [3849] "s__sp. 5420S-77"
## [3850] "s__sp. IVB6214"
## [3851] "s__genosp. L"
## [3852] "s__apinorum"
## [3853] "s__heparinolyticus"
## [3854] "s__ruginosibacter"
## [3855] "s__sp. E602"
## [3856] "s__seoulensis"
## [3857] "s__onnuriiensis"
## [3858] "s__hellenica"
## [3859] "s__sp. PTS2304"
## [3860] "s__abietis"
## [3861] "s__chinense"
## [3862] "s__salsibiostraticola"
## [3863] "s__sp. SK37"
## [3864] "s__sp. CL21"
## [3865] "s__sp. Chiba101"
## [3866] "s__citrulli"
```

```
## [3867] "s__sp. TY2-98"
## [3868] "s__olearius"
## [3869] "s__pantotrophus"
## [3870] "s__sp. R4-39-08"
## [3871] "s__gipuzkoensis"
## [3872] "s__sp. NIBR11"
## [3873] "s__sp. BT-229"
## [3874] "s__sp. C8S0"
## [3875] "s__kunjamensis"
## [3876] "s__endolithicus"
## [3877] "s__argi"
## [3878] "s__respiraculi"
## [3879] "s__bornimense"
## [3880] "s__sp. KACC 23026"
## [3881] "s__desertarenae"
## [3882] "s__sp. PCC 7502"
## [3883] "s__sp. RUD330"
## [3884] "s__sp. SCSIO 64092"
## [3885] "s__sp. MC1"
## [3886] "s__merionis"
## [3887] "s__sp. B4"
## [3888] "s__sp. zg-1006"
## [3889] "s__kimchii"
## [3890] "s__plumbiphila"
## [3891] "s__unzii"
## [3892] "s__phocirhinis"
## [3893] "s__aphrophilus"
## [3894] "s__frederiksbergense"
## [3895] "s__sp. SCUT-3"
## [3896] "s__associata"
## [3897] "s__alkaliphila"
## [3898] "s__cyclinae"
## [3899] "s__ostreae"
## [3900] "s__angulatum"
## [3901] "s__mesophilicum"
## [3902] "s__arachidis"
## [3903] "s__meridiei"
## [3904] "s__ureicelerivorans"
## [3905] "s__acetiphilus"
## [3906] "s__sp. W002"
## [3907] "s__zhangbolii"
## [3908] "s__cavolei"
## [3909] "s__sp. JKS000199"
## [3910] "s__haemophilum"
## [3911] "s__sp. E03"
## [3912] "s__stomatepiae"
## [3913] "s__mesonae"
## [3914] "s__sp. SI"
## [3915] "s__sp. NicSoilB4"
## [3916] "s__zhoupengii"
## [3917] "s__lanthieri"
## [3918] "s__bacilliformis"
## [3919] "s__sp. 'deep sea'"
## [3920] "s__sp. SES19"
```

```
## [3921] "s__iheyensis"
## [3922] "s__decolorationis"
## [3923] "s__zoogloeoides"
## [3924] "s__finegoldii"
## [3925] "s__sp. 135"
## [3926] "s__mobaraensis"
## [3927] "s__violaceus"
## [3928] "s__glutamicum"
## [3929] "s__auensis"
## [3930] "s__saccincola"
## [3931] "s__glycolicus"
## [3932] "s__citronellolis"
## [3933] "s__sp. BB3-R1"
## [3934] "s__aquimarina"
## [3935] "s__sp. FW305-BF8"
## [3936] "s__sp. EG6"
## [3937] "s__insecticola"
## [3938] "s__virtanenii"
## [3939] "s__sp. YGD11-2"
## [3940] "s__fanqingshengii"
## [3941] "s__heparinus"
## [3942] "s__sp. SYK-6"
## [3943] "s__sp. 72-3"
## [3944] "s__rapamycinicus"
## [3945] "s__atratus"
## [3946] "s__sp. PAMC 29467"
## [3947] "s__sp. LS2"
## [3948] "s__viridarii"
## [3949] "s__calvus"
## [3950] "s__wexlerae"
## [3951] "s__sp. PCC 7376"
## [3952] "s__sp. Marseille-Q4943"
## [3953] "s__seriniphilus"
## [3954] "s__sp. Idaho Grape"
## [3955] "s__sp. NB 10"
## [3956] "s__asiaticus"
## [3957] "s__confluentis"
## [3958] "s__sp. PAMC 25486"
## [3959] "s__ventriosum"
## [3960] "s__lanienae"
## [3961] "s__goodii"
## [3962] "s__plautii"
## [3963] "s__sp. M10"
## [3964] "s__sp. ES2-1"
## [3965] "s__welbionis"
## [3966] "s__miroungirhinis"
## [3967] "s__jinshanensis"
## [3968] "s__ubonensis"
## [3969] "s__casuarinae"
## [3970] "s__pettenkoferi"
## [3971] "s__sp. RAC08"
## [3972] "s__marcusii"
## [3973] "s__opacus"
## [3974] "s__salmoniphilum"
```

```
## [3975] "s__saltans"
## [3976] "s__sp. SRCM116780"
## [3977] "s__sp. CE17"
## [3978] "s__sp. R14(2021)"
## [3979] "s__neuii"
## [3980] "s__cavourensis"
## [3981] "s__avidum"
## [3982] "s__albigilva"
## [3983] "s__sp. WMMD714"
## [3984] "s__alpina"
## [3985] "s__sp. PAMC28757"
## [3986] "s__mixta"
## [3987] "s__gilvosporeus"
## [3988] "s__sp. ATCC 55076"
## [3989] "s__pleuropneumoniae"
## [3990] "s__massiliana"
## [3991] "s__etli"
## [3992] "s__chloracetimidivorans"
## [3993] "s__vaccae"
## [3994] "s__corrodens"
## [3995] "s__sp. Ap13"
## [3996] "s__sp. NIBRBAC000506063"
## [3997] "s__sp. ESL0405"
## [3998] "s__formatexigens"
## [3999] "s__sp. MTCC 10508"
## [4000] "s__anophelis"
## [4001] "s__socia"
## [4002] "s__franciscana"
## [4003] "s__sp. MD294"
## [4004] "s__sp. CS13"
## [4005] "s__gozinkensis"
## [4006] "s__catenulatum"
## [4007] "s__infera"
## [4008] "s__marisrubri"
## [4009] "s__diolis"
## [4010] "s__sp. MB263"
## [4011] "s__ginsenosidivorans"
## [4012] "s__stercorarium"
## [4013] "s__sp. B1-46"
## [4014] "s__paraoxydans"
## [4015] "s__acetylenica"
## [4016] "s__harbinense"
## [4017] "s__qingshengii"
## [4018] "s__capsici"
## [4019] "s__sp. AntiMn-1"
## [4020] "s__sp. RHBSTW-01013"
## [4021] "s__exovorus"
## [4022] "s__nordii"
## [4023] "s__sp. Yu-01"
## [4024] "s__exfoliatus"
## [4025] "s__dublinensis"
## [4026] "s__suionicum"
## [4027] "s__toebii"
## [4028] "s__sp. CL-1"
```

```
## [4029] "s__carbonis"
## [4030] "s__sp. Man26"
## [4031] "s__sp. KBS0722"
## [4032] "s__sp. Z16"
## [4033] "s__tianxiuensis"
## [4034] "s__limosus"
## [4035] "s__sp. HDW10"
## [4036] "s__paramesenteroides"
## [4037] "s__sp. FSL H7-0737"
## [4038] "s__ziniensis"
## [4039] "s__alpinus"
## [4040] "s__acnes"
## [4041] "s__beijerinckii"
## [4042] "s__sp. GCEP-101"
## [4043] "s__mediatlanticus"
## [4044] "s__sp. JS20170427COW"
## [4045] "s__pluripotens"
## [4046] "s__fortis"
## [4047] "s__ostraviense"
## [4048] "s__konkukensis"
## [4049] "s__mutans"
## [4050] "s__sp. YC-JY1"
## [4051] "s__tropici"
## [4052] "s__sp. SL191"
## [4053] "s__mundtii"
## [4054] "s__pseudintermedius"
## [4055] "s__sp. SCSIO 75817"
## [4056] "s__sp. HUAS12"
## [4057] "s__braakii"
## [4058] "s__pacificum"
## [4059] "s__sp. CT-WN-B3"
## [4060] "s__thermoluteolus"
## [4061] "s__sp. YS12"
## [4062] "s__triatomae"
## [4063] "s__centenum"
## [4064] "s__tolerans"
## [4065] "s__sp. OMZ 788"
## [4066] "s__sp. RG1"
## [4067] "s__acidaminiphila"
## [4068] "s__ilealis"
## [4069] "s__sp. NM4"
## [4070] "s__sporogenes"
## [4071] "s__sp. PBS-H4"
## [4072] "s__oceanicum"
## [4073] "s__wenshanensis"
## [4074] "s__modesticaldum"
## [4075] "s__shinii"
## [4076] "s__pneumophila"
## [4077] "s__sp. DSM 40868"
## [4078] "s__sp. DG01"
## [4079] "s__endometrii"
## [4080] "s__yuhuli"
## [4081] "s__savannae"
## [4082] "s__sp. BH-3-3-3"
```

```
## [4083] "s__sp. IY07-71"
## [4084] "s__sp. ME-1"
## [4085] "s__vestibularis"
## [4086] "s__hyacinthi"
## [4087] "s__bifidum"
## [4088] "s__proteamaculans"
## [4089] "s__holsaticum"
## [4090] "s__ottawaense"
## [4091] "s__goettingensis"
## [4092] "s__sp. 21MFCrub1.1"
## [4093] "s__sp. Marseille-Q6498"
## [4094] "s__tiedjei"
## [4095] "s__lautus"
## [4096] "s__sp. S1-29"
## [4097] "s__mediterraneensis"
## [4098] "s__luminosum"
## [4099] "s__lemurum"
## [4100] "s__phaeolivaceus"
## [4101] "s__sp. JL.03c"
## [4102] "s__sp. S-1144"
## [4103] "s__jogaejeotgali"
## [4104] "s__sp. MC521"
## [4105] "s__lenticrescens"
## [4106] "s__capricolum"
## [4107] "s__sp. Dent CA1/247"
## [4108] "s__xinghaiensis"
## [4109] "s__sp. BIM B-1768"
## [4110] "s__sp. TH136"
## [4111] "s__glycovorans"
## [4112] "s__saliphilus"
## [4113] "s__pentosus"
## [4114] "s__aegosomatissinici"
## [4115] "s__kirschneri"
## [4116] "s__sp. PB12-B1b"
## [4117] "s__sp. YIM 151497"
## [4118] "s__sp. Pop5"
## [4119] "s__hypermegale"
## [4120] "s__caowuchunii"
## [4121] "s__sp. SL2Y3"
## [4122] "s__parafortuitum"
## [4123] "s__cattleyicolor"
## [4124] "s__sp. RHBSTW-00175"
## [4125] "s__isosaccharinicus"
## [4126] "s__minutum"
## [4127] "s__isatidis"
## [4128] "s__sp. DMT04"
## [4129] "s__sp. 32-5/1"
## [4130] "s__sp. BNL1100"
## [4131] "s__acidiceleris"
## [4132] "s__equinus"
## [4133] "s__succinus"
## [4134] "s__sp. D18"
## [4135] "s__sp. Scap07"
## [4136] "s__chubuense"
```

```
## [4137] "s__sp. KM1"
## [4138] "s__sp. FDAARGOS_192"
## [4139] "s__sp. BuS5"
## [4140] "s__sulfexigens"
## [4141] "s__vulneris"
## [4142] "s__ovolyticum"
## [4143] "s__trachealis"
## [4144] "s__polymorpha"
## [4145] "s__mitis"
## [4146] "s__sp. KTR9"
## [4147] "s__cronae"
## [4148] "s__sp. AM 3-1-1"
## [4149] "s__sp. J2-20"
## [4150] "s__caldifontis"
## [4151] "s__licheniformis"
## [4152] "s__kunzii"
## [4153] "s__sp. PDNC004"
## [4154] "s__austroafricanum"
## [4155] "s__cremoris"
## [4156] "s__yatensis"
## [4157] "s__sp. FZFQ2102"
## [4158] "s__sp. HDW12B"
## [4159] "s__lithophora"
## [4160] "s__ferrinatatus"
## [4161] "s__sp. NP310"
## [4162] "s__varians"
## [4163] "s__milleri"
## [4164] "s__sp. FDAARGOS 1247"
## [4165] "s__sp. 24"
## [4166] "s__dinghuense"
## [4167] "s__sp. SB49"
## [4168] "s__sp. Marseille-Q5346"
## [4169] "s__paragordonae"
## [4170] "s__suipulveris"
## [4171] "s__sp. fl3"
## [4172] "s__nauticus"
## [4173] "s__rubellus"
## [4174] "s__sp. 1D1416"
## [4175] "s__oeni"
## [4176] "s__sp. PAMC21962"
## [4177] "s__alactolyticus"
## [4178] "s__minutus"
## [4179] "s__neptunius"
## [4180] "s__sp. HMT-352"
## [4181] "s__galegae"
## [4182] "s__sp. oral taxon 212"
## [4183] "s__olei"
## [4184] "s__sp. LN180020"
## [4185] "s__drakei"
## [4186] "s__yangtzensis"
## [4187] "s__proteus"
## [4188] "s__meyeri"
## [4189] "s__sp. EMB200-NS6"
## [4190] "s__litorisediminis"
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## [4191] "s__gelatinovorus"
## [4192] "s__shibae"
## [4193] "s__coldseepsis"
## [4194] "s__sp. CoE-012-22"
## [4195] "s__banfieldiae"
## [4196] "s__hathewayi"
## [4197] "s__humi"
## [4198] "s__sp. PHL 2737"
## [4199] "s__sp. COWG"
## [4200] "s__sp. LKL04"
## [4201] "s__naphthae"
## [4202] "s__xianingshaonis"
## [4203] "s__coprocola"
## [4204] "s__sp. CACIAM 03H1"
## [4205] "s__sp. oral taxon 275"
## [4206] "s__alkalilenta"
## [4207] "s__ingrahamii"
## [4208] "s__heyeri"
## [4209] "s__mutanolyticus"
## [4210] "s__upsaliensis"
## [4211] "s__chitinolyticus"
## [4212] "s__lithotrophicus"
## [4213] "s__amalyticus"
## [4214] "s__amylophilus"
## [4215] "s__acidominimus"
## [4216] "s__cladoniae"
## [4217] "s__sandarakinum"
## [4218] "s__sp. 5116S-27"
## [4219] "s__sp. MCM B-1480"
## [4220] "s__sp. NIES-3974"
## [4221] "s__silvaticum"
## [4222] "s__fairfieldensis"
## [4223] "s__sp. Marseille"
## [4224] "s__piscolens"
## [4225] "s__sp. ESL0690"
## [4226] "s__conspicua"
## [4227] "s__elongatum"
## [4228] "s__sp. 6-C"
## [4229] "s__sp. SSW1-36"
## [4230] "s__sp. PCH239"
## [4231] "s__sp. KACC 22765"
## [4232] "s__lydicus"
## [4233] "s__sp. R1AF57"
## [4234] "s__azoreducens"
## [4235] "s__chlorophenolicum"
## [4236] "s__oakridgensis"
## [4237] "s__sp. YC-RL4"
## [4238] "s__nakagawai"
## [4239] "s__sp. M1E.F.Ca.ET.045.02.1.1"
## [4240] "s__septicus"
## [4241] "s__sp. 75"
## [4242] "s__sp. 762G35"
## [4243] "s__dadantii"
## [4244] "s__rarisocia"
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## [4245] "s__calidirosea"
## [4246] "s__sp. So13.3"
## [4247] "s__sp. Marseille-Q4147"
## [4248] "s__davisii"
## [4249] "s__sp. NJS201"
## [4250] "s__flabilis"
## [4251] "s__dassonvillei"
## [4252] "s__sp. oral taxon 478"
## [4253] "s__cristatus"
## [4254] "s__ferruginea"
## [4255] "s__sp. ALD_SL1"
## [4256] "s__sp. OXWO6B1"
## [4257] "s__faviae"
## [4258] "s__cholodnii"
## [4259] "s__sp. RPA4-5"
## [4260] "s__hansenii"
## [4261] "s__sp. L-11A"
## [4262] "s__vinaceum"
## [4263] "s__sp. 1.5R"
## [4264] "s__crocatus"
## [4265] "s__sp. NBSH8"
## [4266] "s__flavida"
## [4267] "s__panareensis"
## [4268] "s__mobile"
## [4269] "s__sp. B2-1-8"
## [4270] "s__ectoiniformans"
## [4271] "s__sp. JA-3-3Ab"
## [4272] "s__caccae"
## [4273] "s__sp. SSWR10-1"
## [4274] "s__gordoncarteri"
## [4275] "s__spizizenii"
## [4276] "s__pelargi"
## [4277] "s__sp. N2270"
## [4278] "s__platensis"
## [4279] "s__sp. PAMC25594"
## [4280] "s__sp. Marseille-Q4063"
## [4281] "s__sp. PK3_47"
## [4282] "s__ambifaria"
## [4283] "s__sp. T9N"
## [4284] "s__spiroformis"
## [4285] "s__sp. UFO1"
## [4286] "s__decontaminans"
## [4287] "s__flexneri"
## [4288] "s__dissulfuricans"
## [4289] "s__sp. M190262"
## [4290] "s__arsenitoxydans"
## [4291] "s__mucilaginosa"
## [4292] "s__sp. JBR18"
## [4293] "s__naphthalenovorans"
## [4294] "s__mitsuokai"
## [4295] "s__sp. VKM Ac-2762"
## [4296] "s__sp. DSM 114396"
## [4297] "s__sp. XSG"
## [4298] "s__choanae"
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## [4299] "s__sp. SynAce01"
## [4300] "s__messinensis"
## [4301] "s__sp. ES.058"
## [4302] "s__coralloides"
## [4303] "s__aquilae"
## [4304] "s__mojavensis"
## [4305] "s__sp. CCTCC M2018092"
## [4306] "s__sp. WCF-2"
## [4307] "s__persica"
## [4308] "s__cenocepacia"
## [4309] "s__sp. PAMC 21323"
## [4310] "s__sp. C052"
## [4311] "s__lugdunensis"
## [4312] "s__sp. A4B17"
## [4313] "s__sp. CCBAU 53421"
## [4314] "s__sp. UP202"
## [4315] "s__sp. WH10"
## [4316] "s__mantenii"
## [4317] "s__lignieresii"
## [4318] "s__psychralcaliphila"
## [4319] "s__oxytoca"
## [4320] "s__fistulariae"
## [4321] "s__mycetoides"
## [4322] "s__wangchenii"
## [4323] "s__hassiacum"
## [4324] "s__valaisiana"
## [4325] "s__sp. ABRD24"
## [4326] "s__meningoseptica"
## [4327] "s__sp. Y-9"
## [4328] "s__nova"
## [4329] "s__caecicola"
## [4330] "s__firmus"
## [4331] "s__endbachense"
## [4332] "s__sp. HUAS 2-6"
## [4333] "s__rwandensis"
## [4334] "s__sp. S02"
## [4335] "s__moraniae"
## [4336] "s__sp. Y3"
## [4337] "s__sp. NML98-0116"
## [4338] "s__sp. MG"
## [4339] "s__lentus"
## [4340] "s__sp. PSBB067"
## [4341] "s__tagluense"
## [4342] "s__herbarum"
## [4343] "s__sp. DBS9H8"
## [4344] "s__sp. NZP2298"
## [4345] "s__agaricidamnosum"
## [4346] "s__sp. BDGP8"
## [4347] "s__castenholzii"
## [4348] "s__pilosa"
## [4349] "s__Candidatus Aquiluna sp. UB-MaderosW2red"
## [4350] "s__sp. P1Y"
## [4351] "s__marthii"
## [4352] "s__sp. PAMC28650"
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## [4353] "s__sp. Pch-M"
## [4354] "s__sp. Aquia_216"
## [4355] "s__marincola"
## [4356] "s__torques-reginae"
## [4357] "s__sp. YMA4"
## [4358] "s__cypripedii"
## [4359] "s__welshimeri"
## [4360] "s__phosphoreum"
## [4361] "s__sakei"
## [4362] "s__sp. ALC3"
## [4363] "s__sp. 364"
## [4364] "s__enteropelogenes"
## [4365] "s__azureus"
## [4366] "s__sp. SOS3"
## [4367] "s__striatum"
## [4368] "s__cibaria"
## [4369] "s__sp. PKUAC-SCTA174"
## [4370] "s__multivorum"
## [4371] "s__diestrammenae"
## [4372] "s__peraridilitoris"
## [4373] "s__zengguangii"
## [4374] "s__yamanorum"
## [4375] "s__stationis"
## [4376] "s__sp. GAS368"
## [4377] "s__sp. YH16040_T"
## [4378] "s__melissae"
## [4379] "s__pronyensis"
## [4380] "s__sp. BS-02"
## [4381] "s__erythrophlei"
## [4382] "s__sp. E2-28"
## [4383] "s__unidentified bacterial endosymbiont"
## [4384] "s__rectiverticillatus"
## [4385] "s__Halalkalibacterium halodurans"
## [4386] "s__sp. MRC013"
## [4387] "s__minutissimum"
## [4388] "s__sp. KD4"
## [4389] "s__sp. CBW1108"
## [4390] "s__steynii"
## [4391] "s__sp. C-145"
## [4392] "s__thymidiniphilus"
## [4393] "s__thermalba"
## [4394] "s__sp. YIM 10"
## [4395] "s__sp. WX"
## [4396] "s__sp. SBC1"
## [4397] "s__inusitata"
## [4398] "s__sp. NEB149"
## [4399] "s__aquarius"
## [4400] "s__croceilyticus"
## [4401] "s__ljungdahlii"
## [4402] "s__boryana"
## [4403] "s__aurulentum"
## [4404] "s__harveyi"
## [4405] "s__hafniense"
## [4406] "s__celeriflavum"
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## [4407] "s__litoris"
## [4408] "s__sp. S6-11"
## [4409] "s__sp. JN-1"
## [4410] "s__bescii"
## [4411] "s__raffinolactis"
## [4412] "s__sp. BG8"
## [4413] "s__doosanense"
## [4414] "s__coniformis"
## [4415] "s__sp. SL85"
## [4416] "s__hansupus"
## [4417] "s__sp. DQ12-45-1b"
## [4418] "s__sp. WZN-1"
## [4419] "s__sp. B1-1-8"
## [4420] "s__sp. A1-5"
## [4421] "s__portensis"
## [4422] "s__macginleyi"
## [4423] "s__gigas"
## [4424] "s__sp. ZM23"
## [4425] "s__sp. SL93"
## [4426] "s__mexicana"
## [4427] "s__sp. JZ28"
## [4428] "s__fumaroli"
## [4429] "s__pasteurianum"
## [4430] "s__gotjawalensis"
## [4431] "s__rufum"
## [4432] "s__sp. LRP2-20"
## [4433] "s__sp. B21-028"
## [4434] "s__fimi"
## [4435] "s__Isorropodon fossajaponicum symbiont"
## [4436] "s__jensenii"
## [4437] "s__sp. SPIII_3"
## [4438] "s__sp. W3-18-1"
## [4439] "s__sp. KC8"
## [4440] "s__sp. Kera 3"
## [4441] "s__sp. B21-047"
## [4442] "s__sp. EM10"
## [4443] "s__glyciniphilum"
## [4444] "s__postgatei"
## [4445] "s__cereus"
## [4446] "s__cyanobacterium endosymbiont of Epithemia clementina EcSB"
## [4447] "s__aeruginosavorus"
## [4448] "s__sp. zg-Y859"
## [4449] "s__ambystomatis"
## [4450] "s__sp. GS7"
## [4451] "s__sp. 'caverna'"
## [4452] "s__parasanguinis"
## [4453] "s__sp. RS39"
## [4454] "s__sp. WH 8109"
## [4455] "s__panuliri"
## [4456] "s__naganoensis"
## [4457] "s__sophorae"
## [4458] "s__conspicuum"
## [4459] "s__sp. SGAir0954"
## [4460] "s__kefirresidentii"
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## [4463] "s__sp. Y8"
## [4464] "s__sp. MA-2"
## [4465] "s__sp. BP30"
## [4466] "s__elkanii"
## [4467] "s__sp. PB12/4term"
## [4468] "s__sp. NZP2077"
## [4469] "s__lepromatosis"
## [4470] "s__sp. PROS-9-1"
## [4471] "s__rapida"
## [4472] "s__sp. R8"
## [4473] "s__sp. NBAIMH1"
## [4474] "s__altitudinis"
## [4475] "s__glycogenica"
## [4476] "s__sp. LPB0142"
## [4477] "s__limnaea"
## [4478] "s__stagnalis"
## [4479] "s__sp. MSR2"
## [4480] "s__sp. IMCC34777"
## [4481] "s__svalbardensis"
## [4482] "s__sp. JL477"
## [4483] "s__sp. csp3"
## [4484] "s__bilis"
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## [4486] "s__sp. 170"
## [4487] "s__fraxinea"
## [4488] "s__sp. WS12"
## [4489] "s__sp. DB-40"
## [4490] "s__sabuli"
## [4491] "s__ehrlichii"
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## [4493] "s__sp. KUDC0405"
## [4494] "s__canalis"
## [4495] "s__lactucae"
## [4496] "s__tsukubensis"
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## [4498] "s__sunii"
## [4499] "s__tetani"
## [4500] "s__sp. WKF16"
## [4501] "s__sp. cB07"
## [4502] "s__sp. MFBS3-15"
## [4503] "s__cellulolyticum"
## [4504] "s__sp. RAC03"
## [4505] "s__sp. NP-4(2019)"
## [4506] "s__alkalaceticum"
## [4507] "s__activa"
## [4508] "s__oriscaviae"
## [4509] "s__sp. YN"
## [4510] "s__sp. Pch-S"
## [4511] "s__sp. KKS102"
## [4512] "s__sp. Z12"
## [4513] "s__sp. TF02-7"
## [4514] "s__theicola"
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## [4516] "s__gallisepticum"
## [4517] "s__xanthomarina"
## [4518] "s__psittacipulmonis"
## [4519] "s__necator"
## [4520] "s__shigaense"
## [4521] "s__halodurans"
## [4522] "s__sp. XY-2"
## [4523] "s__arilaitensis"
## [4524] "s__dispersa"
## [4525] "s__sp. HH130629-09"
## [4526] "s__arcticus"
## [4527] "s__rhodochrous"
## [4528] "s__sp. ABRD_28"
## [4529] "s__sp. THAF82"
## [4530] "s__bemidjiense"
## [4531] "s__alhagi"
## [4532] "s__sp. 4R-513"
## [4533] "s__sp. DL-VIII"
## [4534] "s__sp. ALC70"
## [4535] "s__sp. SCPEA002"
## [4536] "s__jinghuaiqii"
## [4537] "s__sp. M259"
## [4538] "s__alkylphenolica"
## [4539] "s__sp. MC1862"
## [4540] "s__guangdongensis"
## [4541] "s__neonatale"
## [4542] "s__sp. AJA228-03"
## [4543] "s__roseirectus"
## [4544] "s__shigelloides"
## [4545] "s__odontolytica"
## [4546] "s__canimorsus"
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## [4548] "s__sp. JUb54"
## [4549] "s__peoriae"
## [4550] "s__salivibrio"
## [4551] "s__timonense"
## [4552] "s__sp. Ricciae_BoGa-3"
## [4553] "s__sp. ESL0790"
## [4554] "s__sp. 2125159857"
## [4555] "s__faecimaris"
## [4556] "s__macleodii"
## [4557] "s__thuringiensis"
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## [4560] "s__sp. 24E2"
## [4561] "s__graeca"
## [4562] "s__taurus"
## [4563] "s__polytropus"
## [4564] "s__craniellae"
## [4565] "s__sp. W7"
## [4566] "s__sp. I71"
## [4567] "s__euryhalodurans"
## [4568] "s__corsicus"
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## [4573] "s__phaeum"
## [4574] "s__restrictus"
## [4575] "s__sp. VKM Ac-2760"
## [4576] "s__campestrisoli"
## [4577] "s__exhalans"
## [4578] "s__leprae"
## [4579] "s__sp. MWH-Spelu-300-X4"
## [4580] "s__gardneri"
## [4581] "s__sp. JY-7876"
## [4582] "s__stuartii"
## [4583] "s__enterica"
## [4584] "s__sp. NEAU-S7GS2"
## [4585] "s__sp. CBA3102"
## [4586] "s__fastidiosus"
## [4587] "s__rhizogenes"
## [4588] "s__sp. L2-79-05"
## [4589] "s__kroppenstedtii"
## [4590] "s__sp. ST1015"
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## [4592] "s__sp. CS682"
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## [4595] "s__ganghwense"
## [4596] "s__sp. LS1212"
## [4597] "s__geestiana"
## [4598] "s__ishigakiensis"
## [4599] "s__lavendulae"
## [4600] "s__splanchnicus"
## [4601] "s__sp. UDSM-2020"
## [4602] "s__sp. S16"
## [4603] "s__grossiae"
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## [4605] "s__sp. 11-B-312"
## [4606] "s__sp. NLF-5-8"
## [4607] "s__proteinivorum"
## [4608] "s__sp. A6099"
## [4609] "s__serpentiformis"
## [4610] "s__giovannonii"
## [4611] "s__sp. HYN0024"
## [4612] "s__sp. MS455"
## [4613] "s__sp. BDJS001"
## [4614] "s__sp. NtRootA1"
## [4615] "s__sp. CB1024"
## [4616] "s__saccharophila"
## [4617] "s__globerulus"
## [4618] "s__sp. X-1"
## [4619] "s__sp. E4742"
## [4620] "s__tangerina"
## [4621] "s__sp. DMU1"
## [4622] "s__mori"
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## [4623] "s__bethesdensis"
## [4624] "s__sabulinigri"
## [4625] "s__sp. KNUC1210"
## [4626] "s__sp. Mg1"
## [4627] "s__obscurus"
## [4628] "s__sp. 1608163"
## [4629] "s__zengyii"
## [4630] "s__luti"
## [4631] "s__sp. SCG-1"
## [4632] "s__sp. C5510"
## [4633] "s__sp. NIBR2454"
## [4634] "s__boletus"
## [4635] "s__cryptoxanthini"
## [4636] "s__thiophilus"
## [4637] "s__radicincitans"
## [4638] "s__sp. K1W22B-7"
## [4639] "s__sp. UASWS1016"
## [4640] "s__rhusiopathiae"
## [4641] "s__sp. PGU16"
## [4642] "s__sp. T93"
## [4643] "s__sp. KIS68-7"
## [4644] "s__sp. WB94"
## [4645] "s__cryptocerci"
## [4646] "s__psychromarinicola"
## [4647] "s__sp. CF"
## [4648] "s__binhaiensis"
## [4649] "s__sp. Marseille-Q7828"
## [4650] "s__sp. AAP5"
## [4651] "s__sp. L3-i23"
## [4652] "s__youngiae"
## [4653] "s__sp. FeN2"
## [4654] "s__pinxianii"
## [4655] "s__sp. IHBB 10380"
## [4656] "s__sp. Fw109-5"
## [4657] "s__furnissii"
## [4658] "s__sp. Adler-ghost"
## [4659] "s__canariense"
## [4660] "s__producens"
## [4661] "s__pontiacus"
## [4662] "s__sp. BJN0003"
## [4663] "s__multipartita"
## [4664] "s__erdmanii"
## [4665] "s__mayonis"
## [4666] "s__roseola"
## [4667] "s__phymatum"
## [4668] "s__sedlakii"
## [4669] "s__micra"
## [4670] "s__sp. OM7"
## [4671] "s__orientis"
## [4672] "s__sp. AONIH1"
## [4673] "s__inkyongensis"
## [4674] "s__xenophagum"
## [4675] "s__sp. sptzw28"
## [4676] "s__sp. ESL0682"
```

```
## [4677] "s__carotovorum"
## [4678] "s__sp. WSM4906"
## [4679] "s__sp. CCBAU 51753"
## [4680] "s__lariciata"
## [4681] "s__atrarenae"
## [4682] "s__mediterranei"
## [4683] "s__sp. R24"
## [4684] "s__sp. PIA16"
## [4685] "s__ferrophilus"
## [4686] "s__chlorobenzoica"
## [4687] "s__vulturis"
## [4688] "s__drentensis"
## [4689] "s__sanyensis"
## [4690] "s__hallii"
## [4691] "s__gerontici"
## [4692] "s__sp. SCSIO52902"
## [4693] "s__obscuriglobus"
## [4694] "s__sp. TRM1-10"
## [4695] "s__sp. YIM 151385"
## [4696] "s__cetorum"
## [4697] "s__fucicola"
## [4698] "s__amoebiphila"
## [4699] "s__cellanae"
## [4700] "s__sp. LPB0260"
## [4701] "s__mysorens"
## [4702] "s__xylanus"
## [4703] "s__eburnea"
## [4704] "s__liangshanensis"
## [4705] "s__formicoaceticum"
## [4706] "s__russatus"
```

```
# Check the amount of unique taxa in samples which have and have not been treated with antibiotics
subsetMG %>% ps_filter(AB == "no")  # 6014 different taxa for non AB treated
```

```
## phyloseq-class experiment-level object
## otu_table()   OTU Table:         [ 6014 taxa and 102 samples ]
## sample_data() Sample Data:       [ 102 samples by 34 sample variables ]
## tax_table()   Taxonomy Table:    [ 6014 taxa by 7 taxonomic ranks ]
## phy_tree()    Phylogenetic Tree: [ 6014 tips and 6013 internal nodes ]
```

```
subsetMG %>% ps_filter(AB == "yes") # 3148 different taxa for AB treated
```

```
## phyloseq-class experiment-level object
## otu_table()   OTU Table:         [ 3148 taxa and 18 samples ]
## sample_data() Sample Data:       [ 18 samples by 34 sample variables ]
## tax_table()   Taxonomy Table:    [ 3148 taxa by 7 taxonomic ranks ]
## phy_tree()    Phylogenetic Tree: [ 3148 tips and 3147 internal nodes ]
```

```
# 6355 different taxa in total, so 341 taxa are not found in non AB



# Stable "Farm2R1S1"  has the three lowest sampling depths of the dataset, the other nine samples are f
subsetMG %>% ps_filter(FarmRoundStable == c("Farm2R1S1")) %>% sample_sums() %>% sort()
```

```
##     5_54    4_56    4_41    4_38    4_40    4_36    4_57    4_54    4_39    5_55
## 2164863 2171475 2197133 2384366 2692826 2780965 2796239 2906132 3078035 3401482
##     4_55    4_37
## 4528417 5182762
```

```
# factorizing variables as not to create problems with visualization later down the line
sample_data(subsetMG)$Cluster = as.factor(sample_data(subsetMG)$Cluster)
sample_data(subsetMG)$FlockSize = as.factor(sample_data(subsetMG)$FlockSize)
sample_data(subsetMG)$AgeParentStock = as.factor(sample_data(subsetMG)$AgeParentStock)
sample_data(subsetMG)$Age = as.factor(sample_data(subsetMG)$Age)
sample_data(subsetMG)$LibraryNumber = as.factor(sample_data(subsetMG)$LibraryNumber)

# add stable column with shorter names
sample_data(subsetMG)$FarmRoundStable = as.factor(sample_data(subsetMG)$FarmRoundStable)
subsetMG@sam_data$Stables = revalue(sample_data(subsetMG)$FarmRoundStable, c("Farm1R1S1"="Stable1", "Fa
                                                                              "Farm2R2S1"="Stable5", "Fa
                                                                              "Farm4R1S1"="Stable9", "Fa
# Shortening agent names
subsetMG@sam_data$Cox[subsetMG@sam_data$Cox == "narasinandnicarbazin(maxiban)"] = "Maxiban"
subsetMG@sam_data$Cox[subsetMG@sam_data$Cox == "narasin(monteban)"] = "Monteban"
subsetMG@sam_data$Cox[subsetMG@sam_data$Cox == "salinomycin(Sacox120microGranulate)"] = "Sacox"
```

Resistome

loading data

```
### loading a subset of metagenomic data into phyloseq format
Rps= readRDS("Phyloseq_k2") # this reads a pre-existing phyloseq object containing OTU and tax tables,
Rps_mp= readRDS("Phyloseq") # reads in the data with count data corrected with metaphlan bacterial coun
Rps_tpm = readRDS("Phyloseq_tpm") # also read in TPM data instead of FPKM

#We rewrite the sample names to a format filtering out Firm and firm and the first underscore so that i
sample_names(Rps) = sapply(regmatches(sample_names(Rps), regexpr("_", sample_names(Rps)), invert = TRUE
sample_names(Rps_mp) = sapply(regmatches(sample_names(Rps_mp), regexpr("_", sample_names(Rps_mp)), inve
sample_names(Rps_tpm) = sapply(regmatches(sample_names(Rps_tpm), regexpr("_", sample_names(Rps_tpm)), i

# Because the names in both metadata sets do not completely overlap, we need to manually edit one of th
sample_names(Rps)[68] = "4_65"
sample_names(Rps_mp)[68] = "4_65"
sample_names(Rps_tpm)[68] = "4_65"


# reading in and combining metadata from 16S and metagenomic origins, adding missing underscores
firm_names = read_excel("./Metagenomic/FIRM_MetaNames.xlsx")
firm_names = firm_names[,-2] # Remove wrongful Raw_data_name column, to avoid confusion

meta_data = read.csv("MetaData.csv", header = TRUE, sep = ",")
meta_data_R = dplyr::right_join(firm_names, meta_data, by="SampleID")

# using Sample_Unique as rownames so we can match the two sets in phyloseq
rownames(meta_data_R) = meta_data_R$Sample_Unique
```

```r
# now we'll also add in microbial load
microbial_load = read.table("bacterial_load_kraken2.tab", sep = "\t", header = TRUE)
microbial_load$Sample_Unique = sapply(regmatches(microbial_load$Sample_Unique, regexpr("_",microbial_loa
microbial_load$Sample_Unique[68] = "4_65"
meta_data_R = dplyr::right_join(meta_data_R, microbial_load, by="Sample_Unique")

# creating tree and making phyloseq components, adding tree and sample data components to phyloseq
set.seed("877") # setting seed for reproducibility purposes
random_tree = rtree(ntaxa(Rps), rooted=TRUE, tip.label=taxa_names(Rps))
meta_data_R = sample_data(meta_data_R)
rownames(meta_data_R) = meta_data_R$Sample_Unique
Rps = merge_phyloseq(Rps, meta_data_R, random_tree)

# repeat for mp
set.seed("878") # setting seed for reproducibility purposes
random_tree2 = rtree(ntaxa(Rps_mp), rooted=TRUE, tip.label=taxa_names(Rps_mp))
Rps_mp = merge_phyloseq(Rps_mp, meta_data_R, random_tree2)

# repeat for tpm
set.seed("879") # setting seed for reproducibility purposes
random_tree3 = rtree(ntaxa(Rps_tpm), rooted=TRUE, tip.label=taxa_names(Rps_tpm))
Rps_tpm = merge_phyloseq(Rps_tpm, meta_data_R, random_tree3)

# overview data
datatable(tax_table(Rps))
```

```r
rank_names(Rps) # Shows classes and ARGs
```

```
## [1] "AMR_class_primary"   "AMR_class_secondary" "ARGCluster90"
## [4] "ID_ClustRefSequence"
```

```r
sort(get_taxa_unique(Rps, "AMR_class_primary")) # Shows primary AMR classes
```

```
##  [1] "Aminoglycoside" "Beta-lactam"    "Fosfomycin"     "Glycopeptide"
##  [5] "Lincosamide"    "Macrolide"      "Not determined" "Oxazolidinone"
##  [9] "Phenicol"       "Quinolone"      "Streptogramin"  "Sulphonamide"
## [13] "Tetracycline"   "Trimethoprim"
```

```r
sort(sample_sums(Rps)) # Amount of unique "taxa" per sample, the min is 1365.913 and max 44483.138, whi
```

```
##      4_55      4_57      4_36      4_39      4_37     14_34      5_55      5_41
##  1365.915  1746.186  2162.499  2332.954  2466.228  2718.590  3066.586  3172.468
##     10_26     10_22     10_20     14_22     10_67      2_57     14_21      4_56
##  3673.885  3685.018  3729.530  3765.937  3823.575  3839.225  3978.278  4001.996
##      9_17      6_37      11_1     10_59     10_14     10_29     10_12     10_15
##  4093.433  4180.804  4345.176  4424.335  4498.027  4651.786  4689.540  4755.647
##     10_19      10_4      6_55      10_7     14_30     10_69      2_48     14_36
##  4869.370  4877.468  4903.775  4918.347  4936.114  5041.872  5072.382  5106.032
##      4_54      10_8      6_57     10_40      5_40     14_35      9_22     14_20
##  5129.624  5167.848  5190.200  5214.607  5270.470  5336.436  5395.266  5410.307
##      5_54     10_68     14_33     10_34     10_57      2_41      9_16      5_59
```

```
## 5581.891  5584.014  5595.311  5619.167  5671.777  5753.916  5758.922  5795.072
##     10_11      4_65      4_40     10_58      9_21     14_25     10_10     14_29
## 5816.317  5826.670  5838.197  5885.278  5977.274  6024.628  6044.767  6065.843
##     10_44     10_63      2_49      6_36      2_58     14_23      11_3      2_40
## 6105.070  6124.063  6206.665  6234.746  6254.150  6267.295  6268.648  6326.603
##     10_30     10_35     10_13      6_58      6_54      6_56      5_39     10_21
## 6375.700  6392.360  6431.761  6452.046  6506.618  6516.612  6522.346  6581.651
##      6_38     10_25      2_26      2_36     10_51     10_64      4_38      2_56
## 6643.052  6768.292  6862.483  6869.818  6924.205  6937.682  6956.992  6984.465
##     10_52      2_25     10_39      2_29      2_51      2_59      9_19     14_27
## 7060.573  7067.078  7091.217  7169.829  7383.892  7463.646  7528.052  7542.397
##      2_24      4_41      2_52      9_37     10_42      9_38     10_48     10_53
## 7543.974  7558.754  7639.814  7741.943  7759.352  7851.401  7890.425  7894.041
##     10_66      2_50     10_41      9_36     10_33      2_27     10_60      2_39
## 8025.357  8083.126  8104.861  8142.604  8192.787  8365.139  8412.984  8511.399
##      2_23     10_28      9_34     10_43      9_39      2_42      9_35      2_47
## 8613.113  8811.783  8881.043  8927.401  9038.993  9095.792  9217.621  9321.329
##      2_61     10_49      9_18      2_60     10_50      10_2      10_3      10_1
## 9503.493  9672.041  9749.846  9753.045 10461.847 23616.052 27684.887 44483.138
```

```
summary(sample_sums(Rps)) # summary of the sampling depths
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1366    5065    6244    6827    7579   44483
```

```
summary(sample_sums(Rps_mp)) # there are big differences between kraken2 and metaphlan counts data, wit
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   125.5  6816.4 11282.9 16409.8 26186.9 93167.6
```

```
sample_variables(Rps) # metadata variables
```

```
##  [1] "SampleIdentifier" "ResCap"           "Conc...ng..µl."   "SampleID"
##  [5] "LibraryNumber"    "Sample_Unique"    "LibraryName"      "Farm"
##  [9] "Farm2"            "Stable"           "FarmRoundStable"  "Days"
## [13] "Age"              "Sname"            "WeightAnimal"     "Gender"
## [17] "AgeParentStock"   "Hatchery"         "Researcher"       "AB"
## [21] "Abday"            "FlockSize"        "FeedF"            "FeedType"
## [25] "FeedProducent"    "Cox"              "OPG"              "Cluster"
## [29] "LitterType"       "Metagenomics"     "ReadPerc"         "ReadTot"
```

```
taxa_names(Rps) # ARGs (662)
```

```
##   [1] "blaTEM-210_1_KJ484630"         "blaSHV-183_1_HG934764"
##   [3] "aac(6)-Iih_1_AJ584701"         "blaSED1_1_AF321608"
##   [5] "aadA5_1_AF137361"              "blaCTX-M-36_1_AB177384"
##   [7] "tet(M)_3_U08812"               "tet(B)_2_AF326777"
##   [9] "dfrA14_1_KF921535"             "aac(6)-Iw_1_AF031331"
##  [11] "lsa(E)_1_JX560992"             "dfrA5_1_X12868"
##  [13] "tet(44)_1_NZ_ABDU01000081"     "dfrA1_12_AY141977"
##  [15] "aph(2)-Ib_3_KF652098"          "lnu(A)_1_M14039"
```

```
##  [17] "cepA-44_1_U05885"            "aph(3)-Ia_10_EU855787"
##  [19] "mecC_4_HG515014"             "vat(E)_3_AF153312"
##  [21] "blaTEM-182_1_HQ317449"       "blaTEM-127_1_AY368236"
##  [23] "blaZ_1_CP000704"             "cepA_1_U05887"
##  [25] "dfrA5_4_AY139589"            "blaOXA-453_1_KR061507"
##  [27] "tet(O)_1_M18896"             "erm(B)_18_X66468"
##  [29] "ant(9)-Ia_2_M69221"          "aac(3)-IV_1_DQ241380"
##  [31] "blaOXA-474_1_KR182167"       "cat_5_U35036"
##  [33] "blaSHV-50_1_AY288915"        "blaOXA-473_1_KR182166"
##  [35] "blaTEM-213_1_LJEE02000034"   "VanC2XY_2_EU151755"
##  [37] "tet(X4)_1_MK134376"          "tet(G)_1_AF133139"
##  [39] "sul2_5_AY524415"             "blaZ_6_AP003139"
##  [41] "erm(T)_1_M64090"             "blaOXA-322_1_KF203096"
##  [43] "blaOXA-461_1_KR061509"       "tet(Z)_1_AF121000"
##  [45] "tetA(P)_3_AB001076"          "aph(3)-Ia_3_EF015636"
##  [47] "sul2_8_AJ877041"             "blaZ_78_KU607301"
##  [49] "erm(D)_1_M29832"             "cfr(B)_1_KM359439"
##  [51] "blaTEM-197_1_HQ877606"       "blaTEM-17_1_Y14574"
##  [53] "erm(Q)_1_L22689"             "blaOXA-230_1_JQ422054"
##  [55] "blaZ_59_NZ_JVBT01000063"     "tet(M)_4_X75073"
##  [57] "blaOXA-193_1_CP013032"       "blaTEM-225_1_KY432403"
##  [59] "tet(W)_2_AY049983"           "lnu(F)_3_AJ561197"
##  [61] "tet(O/W/32/O/W/O)_2_DQ679926" "aac(3)-IVa_1_X01385"
##  [63] "dfrA1_6_FJ215857"            "blaCTX-M-28_6_AJ549244"
##  [65] "blaTEM-168_1_FJ919776"       "aph(3)-Ia_7_X62115"
##  [67] "aph(3)-Ib_2_AF024602"        "dfrA8_1_U10186"
##  [69] "mecA_9_AB505630"             "mecC_2_FR823292"
##  [71] "blaTEM-11_1_AY874537"        "dfrA12_4_EU650399"
##  [73] "sul2_3_HQ840942"             "cfiA4_1_AB087229"
##  [75] "dfrA17_6_AF180469"           "mecA2_1_AM048811"
##  [77] "qnrS8_1_KF730652"            "blaPEDO-2_1_KP109678"
##  [79] "msr(A)_1_X52085"             "aadA13_1_AY713504"
##  [81] "blaTEM-1C_1_FJ560503"        "lnu(C)_1_AY928180"
##  [83] "sul1_35_AB281182"            "mph(C)_2_AF167161"
##  [85] "blaCTX-M-30_1_AY292654"      "tet(X3)_1_MK134375"
##  [87] "sul1_17_AM746675"            "sul2_11_AY232670"
##  [89] "mef(C)_1_AB571865"           "blaZ_16_JBTH01000015"
##  [91] "VanC3XY_1_AY033764"          "dfrA12_1_FJ763641"
##  [93] "tet(32)_2_EF626943"          "tet(O/W)_3_AM889120"
##  [95] "erm(T)_2_AY894138"           "erm(B)_2_K00551"
##  [97] "blaTEM-35_1_KP860986"        "blaTEM-88_1_AY027590"
##  [99] "qnrB10_2_HM439644"           "VanG2XY_1_FJ872410"
## [101] "tet(M)_13_AM990992"          "blaTEM-166_1_FJ197316"
## [103] "aph(3)-Ib_4_AF313472"        "blaTEM-196_1_JQ034306"
## [105] "cat(pC221)_1_X02529"         "dfrA1_9_AJ238350"
## [107] "dfrA16_1_AF077008"           "aph(3)-Ia_9_EU722351"
## [109] "sul2_1_AF542061"             "blaTEM-83_1_AF427129"
## [111] "cfiA3_1_AB087228"            "cmx_1_U85507"
## [113] "dfrA12_8_AM040708"           "mph(G)_1_AB571865"
## [115] "sul1_3_EU855787"             "blaTEM-176_1_GU550123"
## [117] "tetA(P)_2_L20800"            "tet(K)_1_U38656"
## [119] "blaTEM-104_1_AF516719"       "cfr(C)_1_KX686749"
## [121] "erm(B)_1_JN899585"           "VanHDX_5_AY489045"
## [123] "tet(40)_1_FJ158002"          "blaTEM-70_1_AF188199"
```

```
## [125] "tet(W/32/O)_4_AM710605"        "dfrA17_7_AB196349"
## [127] "blaSHV-26_1_AF227204"          "cfiA2_1_AB087226"
## [129] "mph(B)_1_D85892"               "blaCTX-M-12_1_DQ821704"
## [131] "tet(O/W)-2_1_AY485122"         "msr(C)_2_AF313494"
## [133] "aph(3)-Ia_6_L05392"            "aph(3)-Ia_5_AP004237"
## [135] "aac(6)-aph(2)_1_M13771"        "tet(W/32/O)_3_AM710603"
## [137] "cfxA5_1_AY769934"              "blaCGB-1_1_EF672680"
## [139] "msr(A)_2_AB013298"             "VanC3XY_2_EU151759"
## [141] "sul1_2_U12338"                 "vgb(B)_1_AF015628"
## [143] "blaZ_57_NZ_JURP01000126"       "aadA2b_1_D43625"
## [145] "blaTEM-63_1_AF332513"          "blaZ_30_JGUQ01000012"
## [147] "erm(34)_1_AY234334"            "blaOXA-493_1_CP007774"
## [149] "blaTEM-57_1_FJ405211"          "vat(E)_10_AY043212"
## [151] "dfrA1_8_X00926"                "aadA13_2_NC010643"
## [153] "blaOXA-58_1_AY665723"          "blaTEM-153_1_KC149518"
## [155] "tet(X)_3_AB097942"             "poxtA_1_MF095097"
## [157] "aadA2_2_JQ364967"              "dfrA17_1_FJ460238"
## [159] "blaTEM-128_1_AY368237"         "cml_1_M22614"
## [161] "tet(L)_1_HM235948"             "VanC1XY_2_DQ022190"
## [163] "lnu(B)_1_AJ238249"             "catP_1_U15027"
## [165] "erm(A)_1_X03216"               "blaTEM-227_1_KY418040"
## [167] "erm(C)_15_U82607"              "blaTEM-40_1_FR717535"
## [169] "erm(B)_6_AF242872"             "blaSHV-2a_1_X98102"
## [171] "aadA1_5_JX185132"              "blaOXA-349_1_KF297578"
## [173] "tet(O/W)_1_AM889118"           "sul1_8_JN581942"
## [175] "aph(2)-Ig_1_CP004067"          "blaSHV-64_1_DQ174304"
## [177] "lsa(B)_1_AJ579365"             "tet(O/W/O)-2_1_AY196920"
## [179] "dfrA15_4_AJ867237"             "blaOXA-308_1_APPN01000080"
## [181] "blaZ_8_HE993884"               "cepA-29_1_U05884"
## [183] "mecC_3_KR732654"               "catA1_1_V00622"
## [185] "msr(D)_2_AF274302"             "blaTEM-92_1_AF143804"
## [187] "tetA(P)_1_AB054980"            "erm(D)_3_M77505"
## [189] "aadA17_1_FJ460181"             "vat(E)_5_AJ488494"
## [191] "blaTEM-72_1_AF157553"          "sul2_19_AJ319822"
## [193] "tet(A)_4_AJ517790"             "dfrA29_1_AM237806"
## [195] "lnu(P)_1_FJ589781"             "oqxB_1_EU370913"
## [197] "aph(3)-IIIa_2_AJ490186"        "blaSHV-5_1_X55640"
## [199] "dfrA12_3_KJ568502"             "sul2_9_FJ197818"
## [201] "aadA21_1_AY171244"             "tet(M)_7_FN433596"
## [203] "blaOXA-490_1_KU721147"         "sul2_13_AJ289135"
## [205] "aac(3)-Ia_1_X15852"            "tet(M)_2_X90939"
## [207] "tet(M)_10_EU182585"            "blaOXA-489_1_CP013733"
## [209] "erm(B)_20_AF109075"            "blaSHV-61_1_AJ866284"
## [211] "vanXmurFvanKWI_2_AP008230"     "dfrA12_2_KJ546436"
## [213] "dfrA17_11_JN645876"            "aadA7_1_AF224733"
## [215] "cat(pC233)_1_AY355285"         "blaTEM-47_1_Y10279"
## [217] "blaTEM-138_1_AY853593"         "tet(O)_3_Y07780"
## [219] "VanHDX_1_AF130997"             "dfrA1_15_FM207631"
## [221] "VanHDX_3_AF175293"             "erm(F)_4_M62487"
## [223] "blaTEM-6_1_X57972"             "erm(36)_1_AF462611"
## [225] "aadA2_1_NC_010870"             "sul2_10_AM183225"
## [227] "blaTEM-54_1_AF104442"          "mdf(A)_1_Y08743"
## [229] "erm(F)_3_M17808"               "tet(M)_6_M21136"
## [231] "blaZ_5_AJ302698"               "tet(W/32/O)_2_AM710602"
```

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## [233] "blaSHV-160_1_JX121127"        "sul1_5_EU780013"
## [235] "blaOXA-323_1_KF203097"        "blaTEM-36_1_KY305958"
## [237] "tet(O/W)_5_AM889122"          "tet(Q)_4_Z21523"
## [239] "blaTEM-107_1_AY101764"        "aph(3)-Ia_2_EU287476"
## [241] "erm(F)_1_M14730"              "qnrB19_1_EU432277"
## [243] "dfrA17_2_JN645879"            "blaTEM-85_1_AJ277414"
## [245] "mecA_8_NC_007168"             "tet(A)_2_X00006"
## [247] "cfxA4_1_AY769933"             "ant(6)-Ib_1_FN594949"
## [249] "lsa(A)_1_AY225127"            "aph(3)-Ia_4_AF498082"
## [251] "blaIND-3_1_AF219131"          "tet(S/M)_1_HM367711"
## [253] "tet(W)_1_DQ060146"            "fexB_1_JN201336"
## [255] "erm(C)_1_V01278"              "dfrA1_5_EU089668"
## [257] "dfrA15_2_AF221900"            "aac(3)-VIa_2_NC_009838"
## [259] "aph(2)-If_1_KF652097"         "aac(6)-Iid_1_AJ584700"
## [261] "blaOXA-437_1_KP410856"        "dfrA1_10_AF203818"
## [263] "tet(X)_2_M37699"              "blaZ_21_JGQH01000014"
## [265] "qnrB47_1_JQ349155"            "mecC_1_FR821779"
## [267] "aph(2)-Id_1_AF016483"         "blaOXA-348_1_KF297577"
## [269] "blaCTX-M-23_1_AF488377"       "dfrA14_4_AF393510"
## [271] "blaOXA-331_1_KF203105"        "blaTEM-2_1_X54606"
## [273] "sul1_20_JF262165"             "cfiA1_1_AB087225"
## [275] "dfrA17_4_JQ837988"            "tet(O/32/O)_1_JQ740052"
## [277] "dfrA1_4_AB188271"             "blaZ_39_JHTU01000073"
## [279] "blaTEM-8_1_X65252"            "VanHAX_PA_1_DQ018711"
## [281] "tet(O/W/O)-3_1_EF065524"      "dfrD_1_Z50141"
## [283] "VanH_bc_1_Y15705"             "dfrK_1_FN377602"
## [285] "mecA_3_Y13095"                "blaIND-14_1_HM367709"
## [287] "tetB(P)_1_NC_010937"          "sul1_15_EF667294"
## [289] "blaTEM-55_1_DQ286729"         "VanHDX_2_EU999036"
## [291] "blaOXA-228_1_JQ422053"        "blaOXA-452_1_KR061505"
## [293] "cfiA9_1_AB087234"             "qnrS7_1_KF730651"
## [295] "blaTEM-12_1_M88143"           "tet(A)_1_AJ313332"
## [297] "tet(L)_3_M11036"              "aadA8_1_AF326210"
## [299] "erm(X)_4_NC_005206"           "tet(M)_12_FR671418"
## [301] "blaTEM-99_1_AF397066"         "VanC4XY_1_EU151752"
## [303] "aadA24_1_DQ677333"            "sul2_14_AJ514834"
## [305] "blaTEM-124_1_AY327540"        "dfrA16_3_AY878718"
## [307] "blaCTX-M-54_1_DQ303459"       "tet(B)_3_AJ277653"
## [309] "blaTEM-123_1_AY327539"        "blaTEM-106_1_AY101578"
## [311] "tet(L)_4_D00006"              "floR_2_AF118107"
## [313] "blaTEM-157_1_DQ909059"        "tet(W)_5_AJ427422"
## [315] "erm(B)_26_AF080450"           "sul2_7_HM486907"
## [317] "sul1_14_AJ517791"             "mef(B)_1_FJ196385"
## [319] "tet(J)_1_ACLE01000065"        "qnrS1_1_AB187515"
## [321] "erm(B)_9_AF299292"            "dfrA17_9_FJ807902"
## [323] "ant(6)-Ia_3_KF864551"         "cfiA10_1_AB087227"
## [325] "tet(S)_2_L09756"              "dfrA14_5_DQ388123"
## [327] "aph(3)-Ia_1_V00359"           "tet(S/M)_2_AY534326"
## [329] "VanC1XY_1_AF162694"           "erm(B)_7_AF368302"
## [331] "blaTEM-34_1_KC292503"         "ant(6)-Ia_5_AB247327"
## [333] "cfr(B)_3_KR610408"            "tet(Q)_3_U73497"
## [335] "blaSHV-18_1_AF132290"         "blaOXA-24_1_AJ239129"
## [337] "mph(A)_1_D16251"              "blaTEM-3_1_X64523"
## [339] "qnrS3_1_EU077611"             "erm(X)_3_U21300"
```

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## [341] "aph(2)-Ia_2_AP009486"           "rmtE_1_GU201947"
## [343] "blaOXA-470_1_KR182163"          "blaTEM-122_1_AY307100"
## [345] "tet(W/32/O)_1_AM710601"         "blaTEM-159_1_EF136376"
## [347] "dfrA12_6_AY551331"              "blaTEM-135_1_GQ896333"
## [349] "blaZ_11_AJ400722"               "erm(X)_2_X51472"
## [351] "blaSHV-28_1_AF299299"           "tet(O/32/O)_5_FP929050"
## [353] "ARR-3_4_FM207631"               "sul3_2_AJ459418"
## [355] "tet(M)_9_X56353"                "tet(O/W/O)-1_1_AY196921"
## [357] "erm(T)_4_AJ488494"              "dfrA6_1_Z86002"
## [359] "blaSHV-13_1_AF164577"           "sul1_10_DQ143913"
## [361] "blaOXA-333_1_KF203107"          "blaCTX-M-61_1_EF219142"
## [363] "aph(3)-Ib_5_AF321551"           "aph(6)-Id_1_M28829"
## [365] "dfrG_1_AB205645"                "mecA_2_NC_002951"
## [367] "aph(2)-Ib_2_AF207840"           "lnu(F)_2_DQ836009"
## [369] "sul2_12_AF497970"               "tet(Y)_1_EF495198"
## [371] "tet(44)_2_FN594949"             "dfrA14_3_Z50804"
## [373] "aadA3_1_AF047479"               "aadA8b_2_AM040708"
## [375] "ant(6)-Ia_1_AF330699"           "erm(C)_13_M13761"
## [377] "aac(2)-IIa_1_AB669090"          "blaOXA-512_1_KU726870"
## [379] "erm(B)_23_X72021"               "vat(E)_9_AY043210"
## [381] "str_1_X92946"                   "blaTEM-113_1_AY589494"
## [383] "blaOXA-464_1_KU721146"          "blaTEM-16_1_X65254"
## [385] "qnrB36_1_JN173058"              "erm(B)_12_U18931"
## [387] "blaTEM-93_1_AJ318093"           "aph(2)-Ia_3_AJ536195"
## [389] "cfr(C)_2_CANB01000378"          "blaTEM-33_1_GU371926"
## [391] "tet(O/W/32/O)_2_FM164392"       "aac(3)-VIa_1_M88012"
## [393] "blaOXA-9_1_KQ089875"            "sul1_7_FJ715937"
## [395] "dfrA16_4_EU158182"              "blaSHV-16_1_AF072684"
## [397] "tet(L)_7_X60828"                "blaTEM-186_1_JN227084"
## [399] "blaTEM-29_1_DQ269440"           "aph(2)-Ib_1_AF337947"
## [401] "aph(6)-Id_5_18676889"           "mef(A)_2_U83667"
## [403] "blaTEM-94_1_AJ318094"           "aac(6)-Im_1_AF337947"
## [405] "blaOXA-460_1_KR061508"          "blaCTX-M-116_1_JF966749"
## [407] "blaCTX-M-158_1_KM211691"        "blaOXA-25_1_AF201826"
## [409] "erm(D)_2_L08389"                "dfrA12_7_AB196348"
## [411] "blaTEM-22_1_Y17583"             "cfr(B)_2_KM359438"
## [413] "blaCTX-M-58_1_EF210159"         "blaOXA-451_1_KR061504"
## [415] "mecA_6_BX571856"                "dfrA15_1_AF156486"
## [417] "dfrA16_2_AF174129"              "tet(M)_8_X04388"
## [419] "erm(35)_1_AF319779"             "vat(E)_7_AY043211"
## [421] "blaTEM-76_1_AF190694"           "blaTEM-95_1_AJ308558"
## [423] "cat_2_M35190"                   "blaOXA-471_1_EU086833"
## [425] "fosD_1_KC989517"                "tet(A)_6_AF534183"
## [427] "vat(E)_8_AY043209"              "cfiA6_1_AB087231"
## [429] "aac(6)-Ian_1_AP014611"          "aph(4)-Ia_1_V01499"
## [431] "blaSHV-15_1_AJ011428"           "lsa(A)_3_AY737526"
## [433] "aadA8b_1_AY139603"              "tet(A)_3_AY196695"
## [435] "dfrA1_17_FJ489928"              "blaSHV-55_1_DQ054528"
## [437] "blaTEM-1B_1_AY458016"           "blaTEM-52_1_Y13612"
## [439] "ant(3)-Ia_1_X02340"             "VanGXY_1_AY271782"
## [441] "blaOXA-491_1_KU721148"          "cat(pC194)_1_NC_002013"
## [443] "blaSHV-29_1_AF301532"           "blaTEM-1D_1_AF188200"
## [445] "blaOXA-229_1_JQ422052"          "tet(M)_11_JN846696"
## [447] "cfxA2_1_AF504914"               "dfrA5_2_FJ001870"
```

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## [449] "blaSHV-129_1_GU827715"          "blaTEM-20_1_EU527189"
## [451] "tet(O/W)-1_1_AY485126"          "blaCTX-M-42_1_DQ061159"
## [453] "fmrO_1_Q08325"                  "aadA1_3_JQ414041"
## [455] "aph(6)-Id_3_AB109805"           "aadA24_1_AM711129"
## [457] "blaSHV-24_1_AB023477"           "aph(2)-Ie_1_AY743255"
## [459] "blaOXA-448_1_KR061497"          "tet(B)_1_AP000342"
## [461] "blaTEM-181_1_KM977568"          "erm(C)_9_Y09001"
## [463] "cmlA1_1_M64556"                 "tet(M)_5_U58985"
## [465] "lnu(B)_2_JQ861959"              "tet(S)_1_DQ377340"
## [467] "lnu(G)_1_KX470419"              "VanHBX_2_U35369"
## [469] "str_2_FN435330"                 "tet(33)_1_AY255627"
## [471] "mecA1_3_Y13094"                 "blaCTX-M-138_1_KF526119"
## [473] "tet(O/32/O)_4_AIOQ01000025"     "blaTEM-112_1_AY589493"
## [475] "blaCTX-M-166_1_KU978909"        "erm(C)_3_M17990"
## [477] "blaTEM-164_1_EU274580"          "tet(Q)_2_X58717"
## [479] "aadA22_1_AM261837"              "aadA12_1_AY665771"
## [481] "aph(6)-Id_2_AF024602"           "erm(43)_1_HE650138"
## [483] "blaSHV-31_1_AY277255"           "cfiA14_1_FM200789"
## [485] "dfrA12_10_FM877486"             "tet(K)_2_J01764"
## [487] "sul2_6_FN995456"                "aac(6)-Iak_1_AB894482"
## [489] "tet(O/32/O)_3_NZ_AUJS01000017" "tet(Q)_1_L33696"
## [491] "aadA1_4_JQ480156"               "vat(E)_11_AY043213"
## [493] "erm(C)_14_M12730"               "tet(O/32/O)_2_AJ295238"
## [495] "aac(6)-Iaj_1_AB709942"          "cmlA1_2_AB212941"
## [497] "blaTEM-86_1_AJ277415"           "tet(L)_2_M29725"
## [499] "blaOXA-418_1_KJ997966"          "blaZ_10_FR823292"
## [501] "tet(40)_2_AM419751"             "sul1_9_AY963803"
## [503] "cepA_1_L13472"                  "tet(O)_2_M20925"
## [505] "aadD_2_M19465"                  "aph(3)-Ib_3_AF321550"
## [507] "tet(A)_5_AJ419171"              "blaCTX-M-29_1_AY267213"
## [509] "blaOXA-499_1_KT964029"          "aph(3)-IIIa_3_AB247327"
## [511] "mph(C)_1_AB013298"              "blaOXA-493_1_KU739135"
## [513] "aac(3)-Ib_1_L06157"             "mph(A)_2_U36578"
## [515] "blaZ_7_AP004832"                "dfrA12_5_FR875302"
## [517] "VanC2XY_3_EU151757"             "blaTEM-162_1_EF468463"
## [519] "erm(B)_11_M19270"               "tet(33)_2_DQ390458"
## [521] "tet(O/W/32/O)_5_JQ740053"       "tet(X)_1_GU014535"
## [523] "erm(B)_22_X52632"               "sul2_2_AY034138"
## [525] "mecA_4_AB546266"                "aac(6)-Ii_1_L12710"
## [527] "blaSHV-14_1_AF226622"           "tet(32)_1_EU722333"
## [529] "erm(G)_1_M15332"                "dfrA1_16_FJ001872"
## [531] "blaSHV-25_1_AF208796"           "qnrB82_1_KX372672"
## [533] "blaZ_4_X04121"                  "sul1_11_DQ914960"
## [535] "tet(O/W/32/O)_1_EF065523"       "blaTEM-30_1_AJ437107"
## [537] "dfrA1_1_FJ591049"               "tet(L)_8_AY081910"
## [539] "VanHBX_1_AF192329"              "blaZ_3_CP000732"
## [541] "aadA4_1_Z50802"                 "blaCTX-M-1_1_DQ915955"
## [543] "blaSHV-8_1_U92041"              "blaTEM-15_1_AM849805"
## [545] "blaSHV-60_1_AB302939"           "blaCTX-M-32_2_AJ557142"
## [547] "catB_1_M93113"                  "blaOXA-61_1_AY587956"
## [549] "erm(B)_15_U48430"               "blaOXA-397_1_KM087865"
## [551] "dfrA17_10_AM937244"             "aadA6_1_AF140629"
## [553] "blaTEM-1A_1_HM749966"           "vat(D)_1_L12033"
## [555] "blaTEM-24_1_GQ293500"           "blaSHV-45_1_AF547625"
```

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## [557] "aph(3)-Ib_1_M28829"          "cfxA_1_U38243"
## [559] "blaOXA-96_1_DQ519090"        "blaOXA-450_1_KR061502"
## [561] "blaSHV-40_1_AF535128"        "tet(O/W/32/O/W/O)_1_DQ525023"
## [563] "msr(C)_1_AY004350"           "lnu(F)_1_EU118119"
## [565] "mecA_5_AB546267"             "blaCTX-M-175_1_KT997887"
## [567] "dfrA15_3_DQ647028"           "dfrA1_13_DQ018382"
## [569] "erm(C)_16_AF019140"          "blaSHV-7_1_U20270"
## [571] "erm(X)_1_M36726"             "blaIND-5_1_AY504627"
## [573] "erm(G)_2_L42817"             "msr(D)_3_AF227520"
## [575] "erm(B)_21_U35228"            "ant(6)-Ia_2_KF421157"
## [577] "blaTEM-52C_2_EF141186"       "dfrA1_11_AJ419168"
## [579] "dfrA12_9_DQ995286"           "aph(3)-IIIa_1_AF330699"
## [581] "blaTEM-2_2_AJ251946"         "aadA1_2_FJ591054"
## [583] "blaZ_38_NZ_JEMM01000040"     "tet(O/W)_2_AM889119"
## [585] "mecC2_1_KF955540"            "blaOXA-420_1_AB983359"
## [587] "floR_1_AF071555"             "blaZ_2_CP000731"
## [589] "mef(A)_1_AJ971089"           "blaSHV-46_1_AY210887"
## [591] "blaOXA-26_1_AF201827"        "sul2_21_AB366440"
## [593] "blaTEM-116_1_AY425988"       "aph(3)-IIa_1_X57709"
## [595] "ant(9)-Ia_1_X02588"          "blaTEM-82_1_AF427128"
## [597] "aph(2)-If_2_AY701528"        "aph(3)-IIa_2_V00618"
## [599] "VanLXY_1_EU250284"           "dfrA1_14_AB199789"
## [601] "cepA-49_1_U05886"            "aadD_1_AF181950"
## [603] "aph(3)-VIIa_1_M29953"        "blaSHV-66_1_DQ174306"
## [605] "blaSHV-128_1_GU932590"       "tet(W)_4_FN396364"
## [607] "blaTEM-21_1_Y17582"          "blaOXA-472_1_KR182165"
## [609] "blaTEM-111_1_AF468003"       "cat_3_S48276"
## [611] "blaTEM-96_1_AY092401"        "blaSHV-134_1_HM559945"
## [613] "npmA_1_AB261016"             "erm(B)_10_U86375"
## [615] "blaSHV-35_1_AY070258"        "blaTEM-43_1_U95363"
## [617] "blaACT-9_1_HQ693810"         "qnrB5_1_DQ303919"
## [619] "tet(M)_1_X92947"             "blaTEM-87_1_AF250872"
## [621] "blaOXA-518_1_KU739134"       "cfiA8_1_AB087233"
## [623] "dfrA17_3_JQ414038"           "erm(33)_1_AJ579365"
## [625] "aadA23_1_AJ809407"           "aph(3)-III_1_M26832"
## [627] "sul1_38_BX248359"            "blaZ_68_NZ_CUHK01000055"
## [629] "dfrA14_2_Z50805"             "cepA_6_FR688022"
## [631] "blaTEM-52B_1_AF027199"       "dfrA1_3_GU726913"
## [633] "blaTEM-84_1_AF427130"        "blaTEM-28_1_U37195"
## [635] "tet(W)_3_AJ427421"           "catS_1_X74948"
## [637] "blaOXA-257_1_KC567681"       "mef(A)_4_HG423652"
## [639] "blaZ_34_JJAO01000008"        "aadA7_2_AB114632"
## [641] "tet(S)_3_X92946"             "dfrA17_8_AM932673"
## [643] "tet(O/W)_4_AM889121"         "aadA15_1_DQ393783"
## [645] "blaTEM-198_1_AB700703"       "aph(6)-Ic_1_X01702"
## [647] "aph(6)-Id_4_CP000971"        "erm(C)_2_M19652"
## [649] "mef(A)_3_AF227520"           "aph(3)-Ia_8_Y00452"
## [651] "dfrA1_2_HM055363"            "cfxA3_1_AF472622"
## [653] "erm(C)_10_Y09002"            "qnrS9_1_KF732714"
## [655] "mecA_1_NC_002745"            "dfrA17_5_GU358475"
## [657] "blaTEM-10_1_AF093512"        "VanHAX_PT_1_DQ018710"
## [659] "qnrB81_1_KX372671"           "aadA1b_1_M95287"
## [661] "dfrA1_7_AJ400733"            "qnrS4_1_FJ418153"
```

```r
# Stable "Farm2R1S1"  has the five lowest sampling depths of the dataset, some other samples are also v
Rps %>% ps_filter(FarmRoundStable == c("Farm2R1S1")) %>% sample_sums() %>% sort()
```

```
##     4_55     4_57     4_36     4_39     4_37     5_55     4_56     4_54
## 1365.915 1746.186 2162.499 2332.954 2466.228 3066.586 4001.996 5129.624
##     5_54     4_40     4_38     4_41
## 5581.891 5838.197 6956.992 7558.754
```

```r
# For metaphlan data, Stable "Farm2R1S1 has 11/12 lowest sampling depths of the dataset, and there are
Rps_mp %>% ps_filter(FarmRoundStable == c("Farm2R1S1")) %>% sample_sums() %>% sort()
```

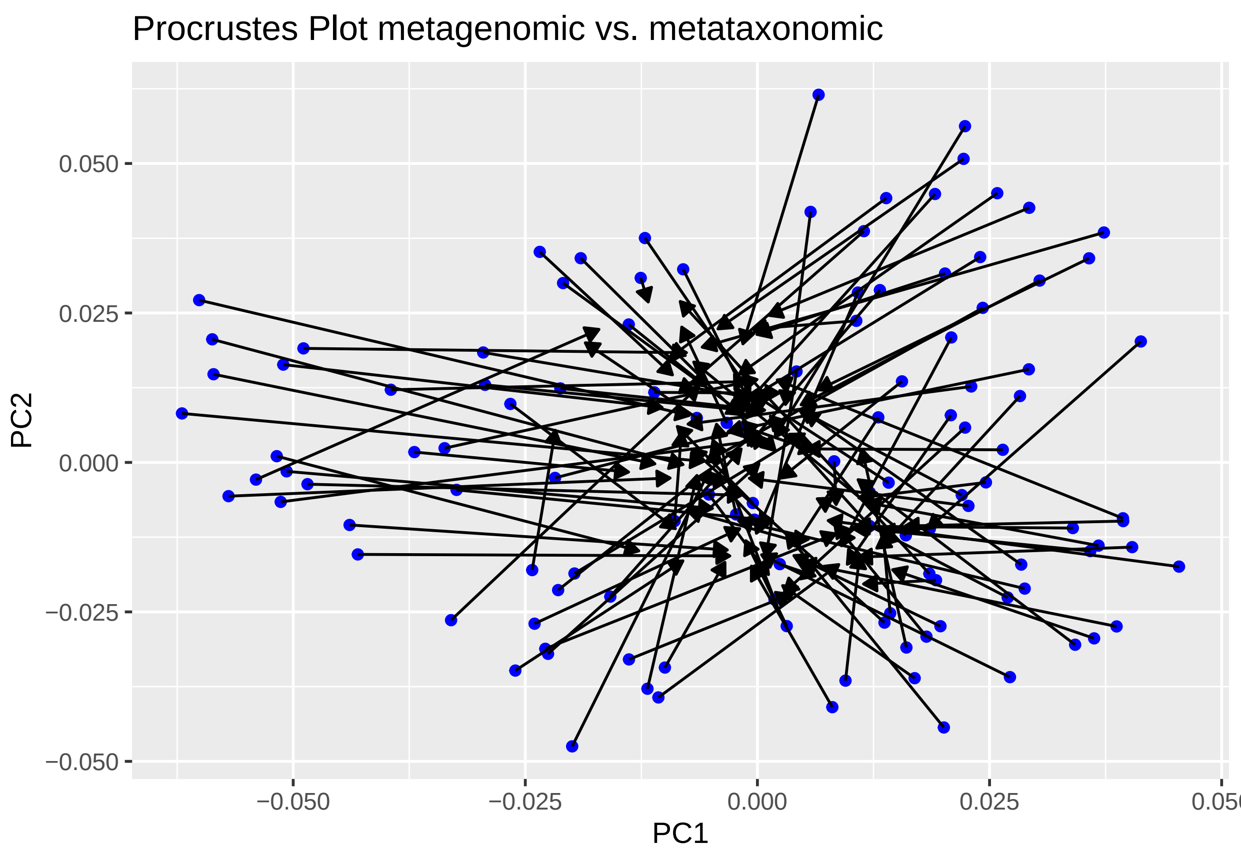
```
##     4_57     4_55     4_36     4_39     4_56     4_37     4_54     5_55
## 125.4769 190.1299 198.9479 211.1739 305.2175 345.8083 394.6092 495.9399
##     5_54     4_40     4_38     4_41
## 521.6233 572.6645 635.2437 822.9736
```

```r
# factorizing variables as not to create problems with visualisation later down the line
sample_data(Rps)$Cluster = as.factor(sample_data(Rps)$Cluster)
sample_data(Rps)$FlockSize = as.factor(sample_data(Rps)$FlockSize)
sample_data(Rps)$AgeParentStock = as.factor(sample_data(Rps)$AgeParentStock)
sample_data(Rps)$Age = as.factor(sample_data(Rps)$Age)
sample_data(Rps)$LibraryNumber = as.factor(sample_data(Rps)$LibraryNumber)

# repeat for MP
sample_data(Rps_mp)$Cluster = as.factor(sample_data(Rps_mp)$Cluster)
sample_data(Rps_mp)$FlockSize = as.factor(sample_data(Rps_mp)$FlockSize)
sample_data(Rps_mp)$AgeParentStock = as.factor(sample_data(Rps_mp)$AgeParentStock)
sample_data(Rps_mp)$Age = as.factor(sample_data(Rps_mp)$Age)
sample_data(Rps_mp)$LibraryNumber = as.factor(sample_data(Rps_mp)$LibraryNumber)

# repeat for TPM
sample_data(Rps_tpm)$Cluster = as.factor(sample_data(Rps_tpm)$Cluster)
sample_data(Rps_tpm)$FlockSize = as.factor(sample_data(Rps_tpm)$FlockSize)
sample_data(Rps_tpm)$AgeParentStock = as.factor(sample_data(Rps_tpm)$AgeParentStock)
sample_data(Rps_tpm)$Age = as.factor(sample_data(Rps_tpm)$Age)
sample_data(Rps_tpm)$LibraryNumber = as.factor(sample_data(Rps_tpm)$LibraryNumber)

# add stable column with shorter names
sample_data(Rps)$FarmRoundStable = as.factor(sample_data(Rps)$FarmRoundStable)
Rps@sam_data$Stables = revalue(sample_data(Rps)$FarmRoundStable, c("Farm1R1S1"="Stable1", "Farm1R1S2"="S
                                                                   "Farm2R2S1"="Stable5", "Fa
                                                                   "Farm4R1S1"="Stable9", "Fa
# Shortening agent names
Rps@sam_data$Cox[Rps@sam_data$Cox == "narasinandnicarbazin(maxiban)"] = "Maxiban"
Rps@sam_data$Cox[Rps@sam_data$Cox == "narasin(monteban)"] = "Monteban"
Rps@sam_data$Cox[Rps@sam_data$Cox == "salinomycin(Sacox120microGranulate)"] = "Sacox"

# repeat
sample_data(Rps_mp)$FarmRoundStable = as.factor(sample_data(Rps_mp)$FarmRoundStable)
Rps_mp@sam_data$Stables = revalue(sample_data(Rps_mp)$FarmRoundStable, c("Farm1R1S1"="Stable1", "Farm1R
                                                                   "Farm2R2S1"="Stable5", "Fa
                                                                   "Farm4R1S1"="Stable9", "Fa
```

```
Rps_mp@sam_data$Cox[Rps_mp@sam_data$Cox == "narasinandnicarbazin(maxiban)"] = "Maxiban"
Rps_mp@sam_data$Cox[Rps_mp@sam_data$Cox == "narasin(monteban)"] = "Monteban"
Rps_mp@sam_data$Cox[Rps_mp@sam_data$Cox == "salinomycin(Sacox120microGranulate)"] = "Sacox"

sample_data(Rps_tpm)$FarmRoundStable = as.factor(sample_data(Rps_tpm)$FarmRoundStable)
Rps_tpm@sam_data$Stables = revalue(sample_data(Rps_tpm)$FarmRoundStable, c("Farm1R1S1"="Stable1", "Farm
                                                                             "Farm2R2S1"="Stable5", "Fa
                                                                             "Farm4R1S1"="Stable9", "Fa
Rps_tpm@sam_data$Cox[Rps_tpm@sam_data$Cox == "narasinandnicarbazin(maxiban)"] = "Maxiban"
Rps_tpm@sam_data$Cox[Rps_tpm@sam_data$Cox == "narasin(monteban)"] = "Monteban"
Rps_tpm@sam_data$Cox[Rps_tpm@sam_data$Cox == "salinomycin(Sacox120microGranulate)"] = "Sacox"

# In order to create taxa prevalence plots, and many more functions, we need to change our "taxa" level
# We'll make a copy to fulfill these purposes
# Phylum = AMR_class_primary, Class = AMR_class_secondary, Order = ARGCluster90, Family = ID_Clust_Refs
Rps_copy = Rps
colnames(Rps_copy@tax_table) = c("Phylum", "Class", "Order","Family")
Rps_mp_copy = Rps_mp
colnames(Rps_mp_copy@tax_table) = c("Phylum", "Class", "Order","Family")
```

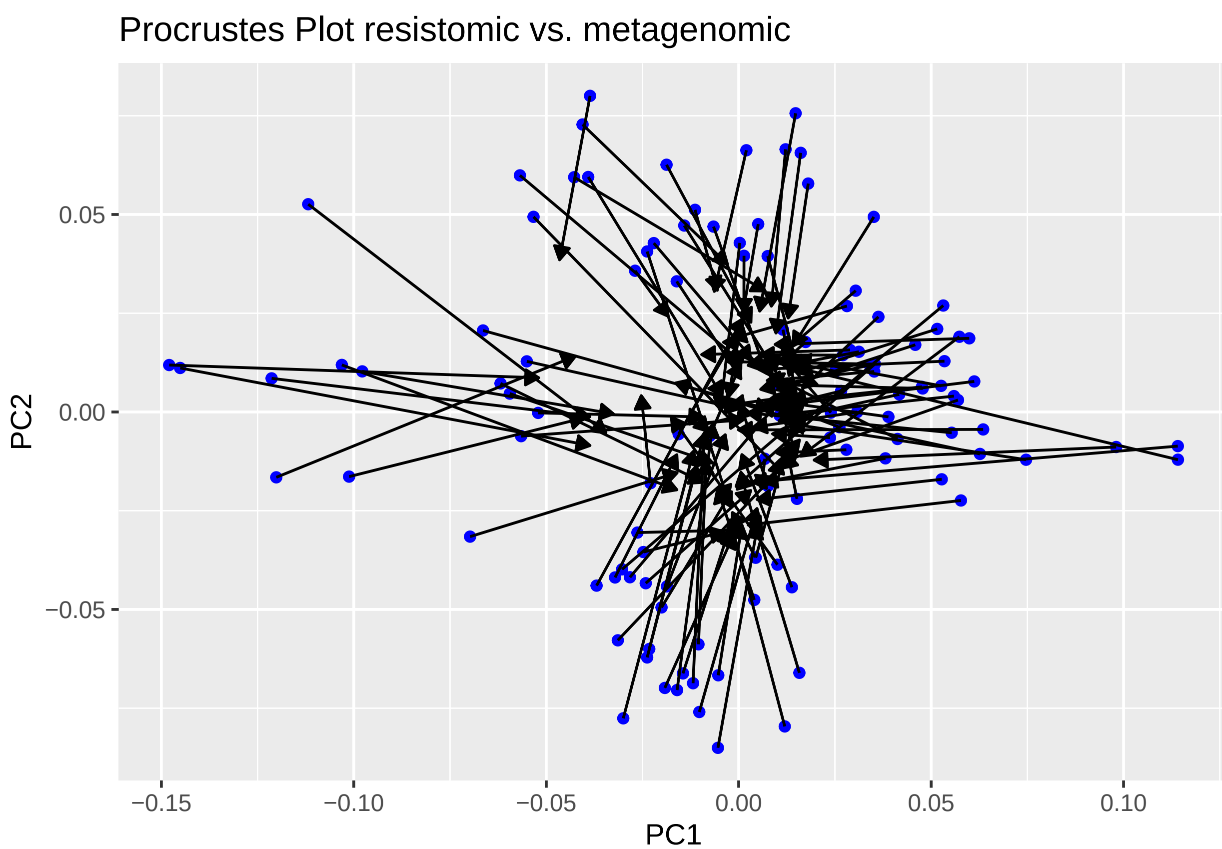
Procrustes plots

```
#Procrustes analyses
copy16S = subset16S
# get the samples in the same order
sample_names(copy16S) = sample_names(subsetMG)

PCoA_BC_16s = ordinate(copy16S, "PCoA")
PCoA_BC_MG = ordinate(subsetMG, "PCoA")
procrustes = protest(PCoA_BC_16s$vectors, PCoA_BC_MG$vectors)

plot_data <- data.frame(
  MT_PC1 = procrustes$X[, 1],
  MT_PC2 = procrustes$X[, 2],
  MG_PC1 = procrustes$Yrot[, 1],
  MG_PC2 = procrustes$Yrot[, 2])

# with arrows pointing from MG to 16S
ggplot(plot_data) +
  geom_point(aes(x=MT_PC1, y=MT_PC2), color = "blue") +
  geom_segment(aes(x=MT_PC1,y=MT_PC2,xend=MG_PC1,yend=MG_PC2),arrow=arrow(type = "closed", length=unit(
  labs(title = "Procrustes Plot metagenomic vs. metataxonomic", x = "PC1", y = "PC2") +
  scale_color_manual(values = c("16S" = "black", "MG" = "blue"))
```

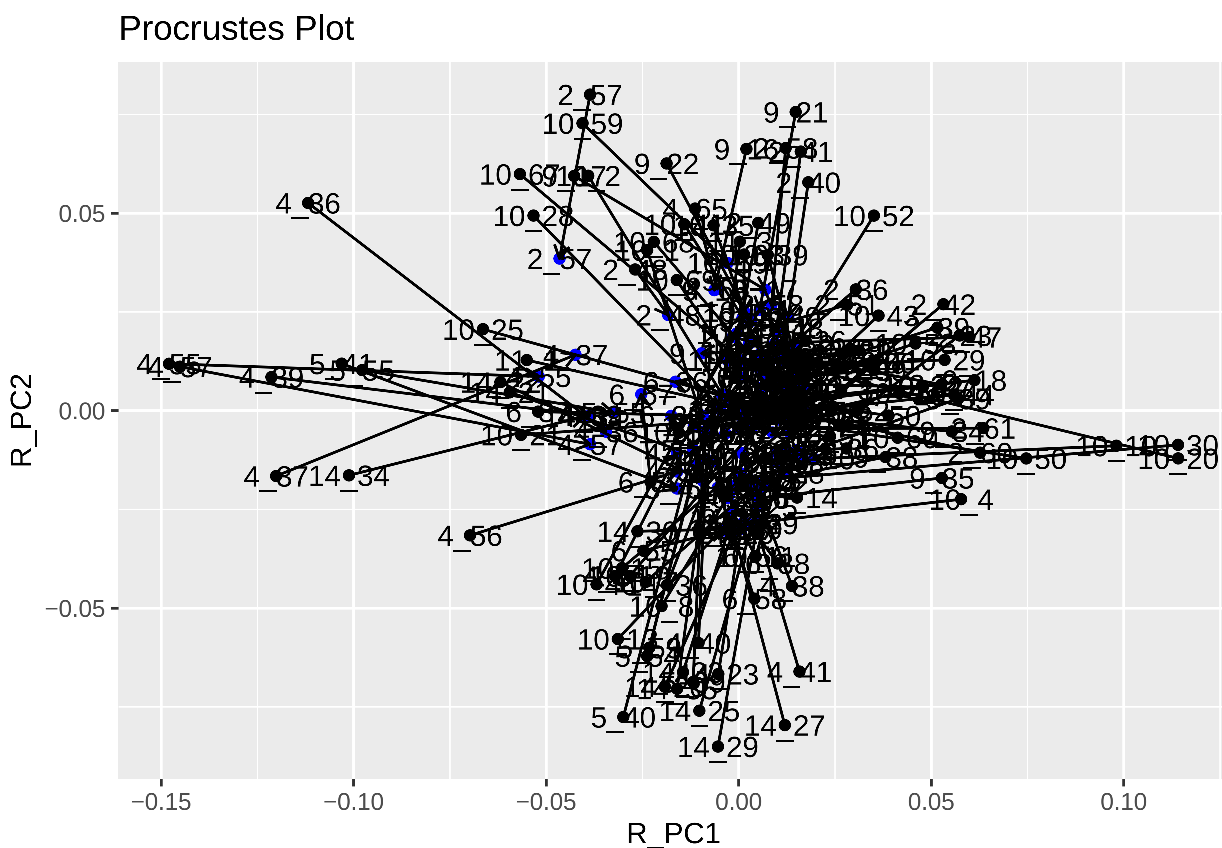



```
# plot with both points
#ggplot(plot_data) +
#  geom_point(aes(x=MT_PC1, y=MT_PC2), color = "green") +
#  geom_point(aes(x=MG_PC1, y=MG_PC2), color = "blue") +
#  geom_segment(aes(x = MT_PC1, xend = MG_PC1, y = MT_PC2, yend = MG_PC2), linetype = "solid") +
#  labs(title = "Procrustes Plot Metataxonomic vs metagenomic")

# Resistome vs MG
copyRps = Rps
# get the samples in the same order
sample_names(copyRps) = sample_names(subsetMG)

PCoA_BC_Rps = ordinate(copyRps, "PCoA")
PCoA_BC_MG = ordinate(subsetMG, "PCoA")
procrustes = protest(PCoA_BC_Rps$vectors, PCoA_BC_MG$vectors)

plot_data <- data.frame(
  R_PC1 = procrustes$X[, 1],
  R_PC2 = procrustes$X[, 2],
  MG_PC1 = procrustes$Yrot[, 1],
  MG_PC2 = procrustes$Yrot[, 2])

# resistome (k2) points to MG
ggplot(plot_data) +
  geom_point(aes(x=R_PC1, y=R_PC2), color = "blue") +
  geom_segment(aes(x=R_PC1,y=R_PC2,xend=MG_PC1,yend=MG_PC2),arrow=arrow(type = "closed", length=unit(0.
```

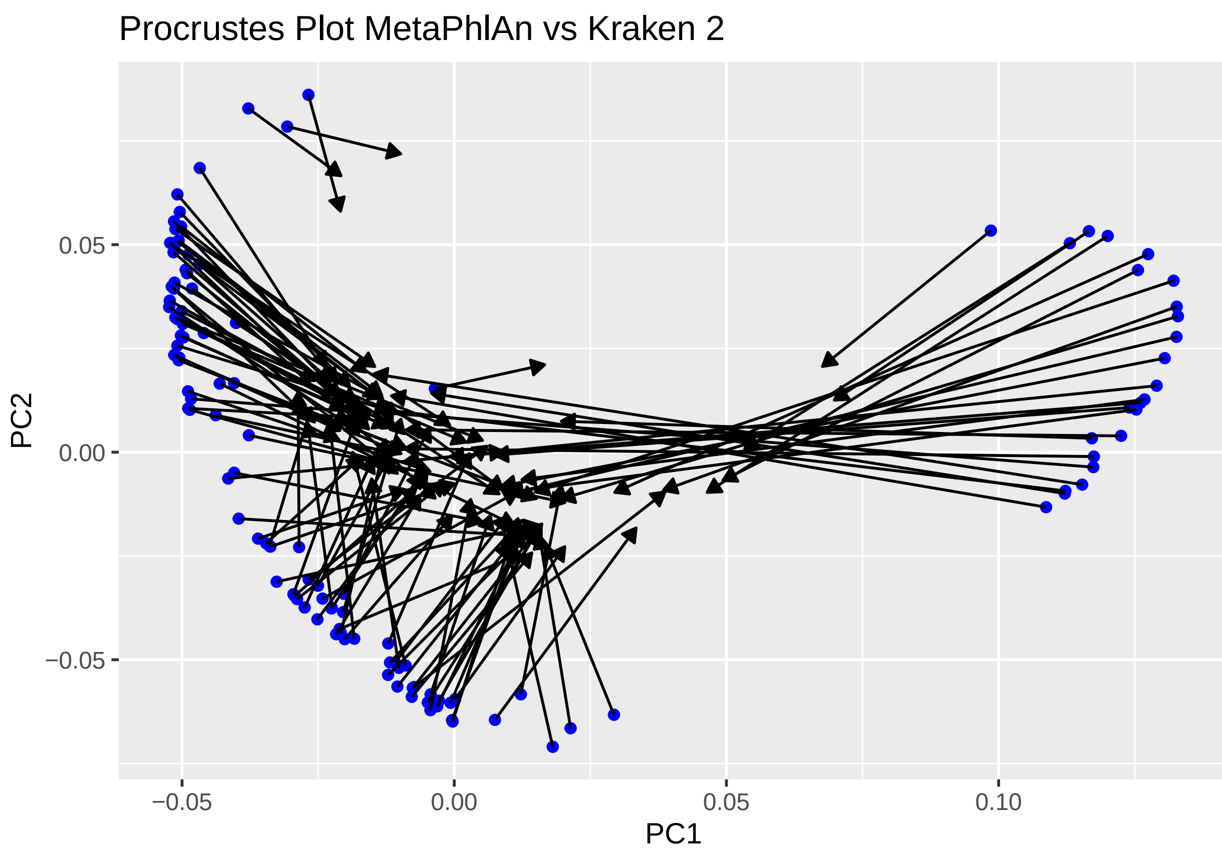
```
  scale_color_manual(values = c("16S" = "black", "MG" = "blue")) +
  guides(color = guide_legend(title = "Data Type")) +
  labs(title = "Procrustes Plot resistomic vs. metagenomic", x = "PC1", y = "PC2")
```




```
# adds labels to see if samples line up
ggplot(plot_data) +
  geom_point(aes(x=R_PC1, y=R_PC2)) +
  geom_point(aes(x=MG_PC1, y=MG_PC2), color = "blue")+
  geom_segment(aes(x=R_PC1,y=R_PC2,xend=MG_PC1,yend=MG_PC2),arrow=arrow(length=unit(0.2,"cm"))) +
  geom_text(aes(x = MG_PC1, y = MG_PC2, label = rownames(plot_data))) +
  geom_text(aes(x = R_PC1, y = R_PC2, label = rownames(plot_data))) +
  labs(title = "Procrustes Plot")
```




```r
# MP vs k2
PCoA_BC_MP = ordinate(Rps_mp, "PCoA")
PCoA_BC_k2 = ordinate(Rps, "PCoA")
procrustes = protest(PCoA_BC_MP$vectors, PCoA_BC_k2$vectors)

plot_data <- data.frame(
  MP_PC1 = procrustes$X[, 1],
  MP_PC2 = procrustes$X[, 2],
  k2_PC1 = procrustes$Yrot[, 1],
  k2_PC2 = procrustes$Yrot[, 2])

ggplot(plot_data) +
  geom_point(aes(x=MP_PC1, y=MP_PC2), color = "blue") +
  geom_segment(aes(x=MP_PC1,y=MP_PC2,xend=k2_PC1,yend=k2_PC2),arrow=arrow(type = "closed", length=unit(
  labs(title = "Procrustes Plot MetaPhlAn vs Kraken 2", x = "PC1", y = "PC2") +
  scale_color_manual(values = c("16S" = "black", "MG" = "blue")) +
  guides(color = guide_legend(title = "Data Type"))
```



Procrustes Plot MetaPhlAn vs Kraken 2
PC2
0.05
0.00
−0.05
−0.05
0.00
0.05
0.10
PC1