Resource Heterogeneity Structures Microbial Communities

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Introduction

Much is already know about how spatial gradients in resource availability contribution to the structure and fucntion of microbial communities. However, we are begining to appreciate the molecular diversity within the resource pool. In this study, we explore how both the concentration and diversity of resources contribute to the structure and function of aquatic microbial communities.

Initial Setup

```
rm(list=ls())
getwd()
setwd("~/GitHub/ResourceHeterogeneity/analyses")

# Import Tools and Standard Functions
source("../bin/MothurTools.R")
se <- function(x, ...){sd(x, na.rm = TRUE)/sqrt(length(na.omit(x)))}

# Save Standard Plot Settings
opar <- par(no.readonly = TRUE)  # Saves plot defaults

# Load Required Packages
require("xtable")
require("png")
require("grid")
require("vegan")
require("RgoogleMaps")
library("maps")
library("mapdata")
```

Supplemental Figure 1: Study System Map

We sampled 10 lakes in the Huron Mountains of Michigan. The Huron Mountains are located in the Superior Bedrock Uplands region of the Michigan Upper Peninsula (Schaetzl et al 2013). The region is classified as .... The forests around the lakes are .... The wetershed is ....

```
png(filename="../figures/Supp1.png",
    width = 1800, height = 900, res = 96*2)
par(opar)
par(mfrow = c(1,1), mar = c(0, 0, 0, 0), oma = c(0, 0, 0, 0) + 0.5)
```

```r
# quartz(width = 9, height = 4.5)
newmap1 <- GetMap(center = c(46.86, -87.93), zoom = 13,
                  maptype = "terrain", GRAYSCALE = FALSE, frame = FALSE,
                  path = "&style=feature:all|element:labels|visibility:off")
newmap2 <- GetMap(center = c(46.86, -87.82), zoom = 13,
                  maptype = "terrain", GRAYSCALE = FALSE, frame = FALSE,
                  path = "&style=feature:all|element:labels|visibility:off")

layout( matrix(c(1,1,1,1,1,1,
                 1,1,1,1,1,1,
                 1,1,1,1,1,1,
                 2,2,2,2,2,2,
                 2,2,2,3,3,3,
                 2,2,2,3,3,3), 6, 6, byrow = FALSE),
        widths = rep(2, 6), heights = rep(2, 6))

# Left Side
PlotOnStaticMap(newmap1, zoom = 13, cex = 2, col = "blue")
text(-120, 270, "Howe", col="red", cex=1.2)
text(100, 255, "Rush", col="red", cex=1.2)
text(105, 55, "Mountain", col="red", cex=1.2)
arrows(10, 100, x1 = -10, y1 = 100, length=0.05, col = "red", lwd = 2, code = 1)
text(-36, 100, "Ann", col="red", cex=1.2)
arrows(60, 230, x1 = 40, y1 = 230, length=0.05, col = "red", lwd = 2, code = 1)
text(8, 230, "Pony", col="red", cex=1.2)
arrows(55, -230, x1 = 75, y1 = -230, length=0.05, col = "red", lwd = 2, code = 1)
text(120, -230, "Canyon", col="red", cex=1.2)

# Right Side
PlotOnStaticMap(newmap2, zoom = 13, cex = 2, col = "blue")
text(-180, -90, "Ives", col="red", cex=1.2)
arrows(-160, 20, x1 = -140, y1 = 20, length=0.05, col = "red", lwd = 2, code = 1)
text(-75, 20, "Upper Pine", col="red", cex=1.2)
arrows(-220, 80, x1 = -200, y1 = 80, length=0.05, col = "red", lwd = 2, code = 1)
text(-125, 80, "Second Pine", col="red", cex=1.2)
arrows(-55, -105, x1 = -35, y1 = -105, length=0.05, col = "red", lwd = 2, code = 1)
text(-12, -105, "Lily", col="red", cex=1.2)

arrows(280, 280, 280, 240, length = 0.1, col = "black", lwd = 3, code = 1)
text(280, 220, "N", col="black", cex = 1.5)

# Inset
map("state", "Michigan", col="gray80", fill=TRUE, xlim=c(-92,-82), ylim=c(41, 48))
points(-87.89, 46.8, pch = 20, col="red")

dev.off() # this writes plot to folder
graphics.off() # shuts down open devices
par(opar)
```

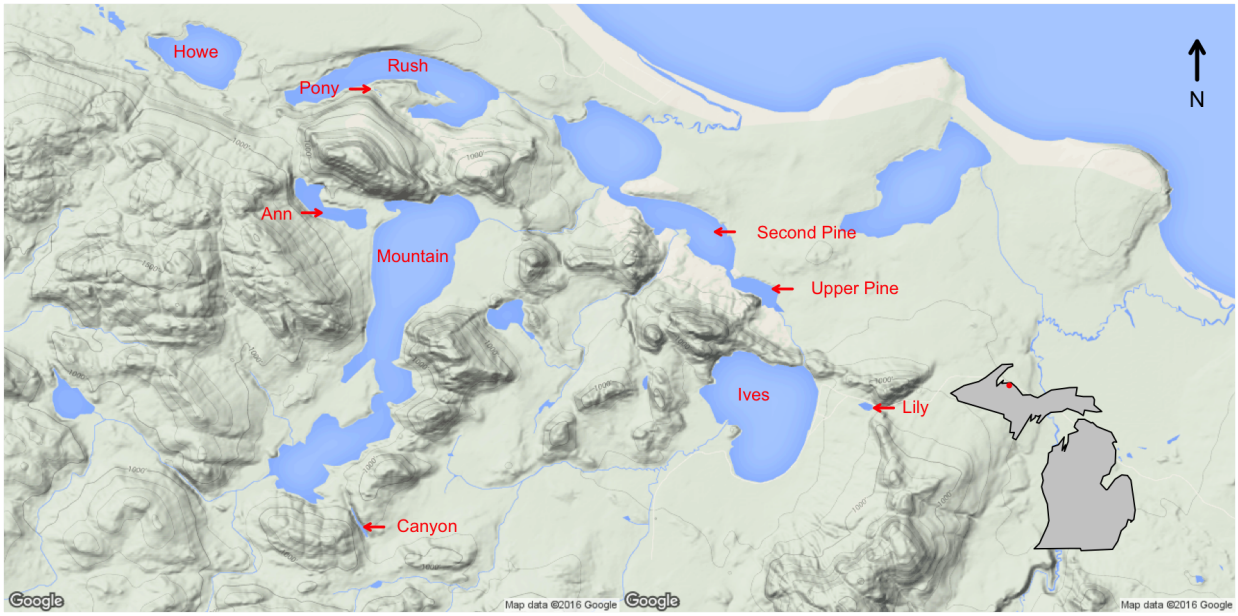


Figure 1: Study System Map

Lake Nutrient Concentrations

```
# DOC
DOC2011 <- read.delim("../data/2011DOC_data.txt", header=T)
DOC2012 <- read.delim("../data/2012DOC_data.txt", header=T)
DOC <- rbind(DOC2011, DOC2012)
DOC <- DOC[grep("MEM*", DOC$Sample), ]
colnames(DOC) <- c("sample", "conc", "LCL", "UCL", "se")
DOCkey <- read.delim("../data/DOC_KEY_epi.txt", header=T)
DOC$code <- DOC$sample
DOC <- DOC[which(DOC$code %in% DOCkey$Sample.Name), ]
DOC$sample <- DOCkey$Site[match(DOCkey$Sample.Name, DOC$code)]
DOC$year <- substr(DOC$code, 4, 7)
DOC$conc <- pmax(DOC$conc, 0)
DOC2 <- data.frame("sample" = DOC$sample, "year" = DOC$year,
                   "conc" =  DOC$conc)[order(DOC$sample, DOC$year), ]
DOC$sample[grep("Pony", DOC$sample)] <- "Pony"
DOC <- droplevels(DOC)

# Total Nitrogen
TN2011 <- read.delim("../data/2011TN_data.txt", header=T)
TN2012 <- read.delim("../data/2012TN_data.txt", header=T)
TN <- rbind(TN2011, TN2012)
TN <- TN[grep("MEM*", TN$Sample), ]
colnames(TN) <- c("sample", "conc", "LCL", "UCL", "se")
TNkey <- read.delim("../data/DOC_KEY_epi.txt", header=T)
TN$code <- TN$sample
TN <- TN[which(TN$code %in% TNkey$Sample.Name), ]
TN$sample <- TNkey$Site[match(TNkey$Sample.Name, TN$code)]
```

```
TN$year <- substr(TN$code, 4, 7)
TN$conc <- pmax(TN$conc, 0)
TN2 <- data.frame("sample" = TN$sample, "year" = TN$year,
                  "conc" = TN$conc)[order(TN$sample, TN$year), ]
TN$sample[grep("Pony", TN$sample)] <- "Pony"
TN <- droplevels(TN)

# Total Phosphorus
TP2011 <- read.delim("../data/2011TP_data.txt")
TP2012 <- read.delim("../data/2012TP_data.txt")
TP2011$year <- rep("2011", dim(TP2011)[1])
TP2012$year <- rep("2012", dim(TP2012)[1])
TP <- rbind(TP2011, TP2012)
TP <- TP[grep("*iltered", TP$Sample), ]
colnames(TP) <- c("sample", "conc", "LCL", "UCL", "se", "year")
TP$code <- TP$sample
TDP <- TP[grep("*Filtered", TP$sample), ]
TP <- TP[grep("*Unfiltered", TP$sample), ]
TP$sample <- gsub(" Unfiltered", "", TP$sample)
TDP$sample <- gsub(" Filtered", "", TDP$sample)
TP[6, ] <- TDP[6, ]
TP <- TP[-c(which(TP$sample == "CanyonHypo" | TP$sample == "CanyonChemo")), ]
TP$sample <- gsub("CanyonEpi", "Canyon", TP$sample)
TP$sample <- as.factor(TP$sample)
TP$conc <- pmax(TP$conc, 0)
TP2 <- data.frame("sample" = TP$sample, "year" = TP$year,
                  "conc" = TP$conc)[order(TP$sample, TP$year), ]
TP$sample[grep("Pony", TP$sample)] <- "Pony"
TP <- droplevels(TP)
```

Save Data Table

```
DOC2 <- aggregate(conc ~ sample + year, DOC2, mean)
TN2 <- aggregate(conc ~ sample + year, TN2, mean)
TP2 <- aggregate(conc ~ sample + year, TP2, mean)

nuts <- data.frame("sample" = DOC2$sample, "year" = DOC2$year,
              "DOC" = DOC2$conc, "TP" = TP2$conc, "TN" = TN2$conc)

nuts <- data.frame(nuts[-which(nuts$sample == "Pony.N"), ])
nuts$sample[grep("Pony", nuts$sample)] <- "Pony"
nuts <- droplevels(nuts)
```

Table 1: Lake Nutrients

```
nuts2 <- data.frame(matrix(NA, 10, 4))
row.names(nuts2) <- levels(nuts$sample)
colnames(nuts2) <- c("DOC11", "DOC12", "TP11", "TP12")
for (i in row.names(nuts2)){
```

```
  nuts2[i, 1] <- round(nuts[nuts$sample == i & nuts$year == "2011", 3], 2)
  nuts2[i, 2] <- round(nuts[nuts$sample == i & nuts$year == "2012", 3], 2)
  nuts2[i, 3] <- round(nuts[nuts$sample == i & nuts$year == "2011", 4], 2)
  nuts2[i, 4] <- round(nuts[nuts$sample == i & nuts$year == "2012", 4], 2)
}

addtorow <- list()
addtorow$pos <- list(0, 0)
addtorow$command <- c("& \\multicolumn{2}{c}{DOC (mg C/L)} &
                      \\multicolumn{2}{c}{TP ($\\mu$g P/L)} \\\\\n",
                      "Lake & 2011 & 2012 & 2011 & 2012 \\\\\n")
nut.tab <- xtable(nuts2)
align(nut.tab) <- "crrrr"
print(nut.tab, add.to.row = addtorow, include.colnames = FALSE,
      type= "latex", file="../tables/table1.tex", hline.after = c(-1, -1, 0, nrow(nut.tab)))
print(nut.tab, add.to.row = addtorow, include.colnames = FALSE, comment = FALSE, hline.after = c(-1, -1
```

	DOC (mg C/L)		TP (μg P/L)	
Lake	2011	2012	2011	2012
Ann	6.15	5.97	3.98	7.27
Canyon	7.62	7.23	2.45	2.64
Howe	6.88	7.04	1.86	5.21
Ives	9.54	6.91	1.35	9.15
Lily	13.36	14.35	4.74	11.55
Mountain	5.41	5.27	2.11	4.87
Pony	31.65	28.99	1.52	49.95
Rush	4.44	4.22	3.55	3.84
SecondPine	7.20	6.26	10.76	12.92
UpperPine	7.99	7.84	2.96	11.21

Figure 1: Lake Nutrients

```
png(filename="../figures/Figure1.png",
    width = 1600, height =1200, res = 96*2)
par(opar)
par(mfrow = c(1,1), mar = c(0, 6, 0, 0) + 0.5, oma = c(4, 0, 1, 1) + 0.5)
layout(rbind(1, 2, 3), height = c(3, 3, 3))

labs <- c("Ann", "Canyon", "Howe", "Ives", "Lily", "Mountain", "Pony", "Rush",
         "Second\nPine","Upper\nPine")

# DOC Plot
plot(DOC$conc ~ DOC$sample, ylim = c(0, 35), las = 1,
     xaxt="n", xlab = "", yaxt="n", ylab = "")
axis(side=1, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=1, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=2, lwd.ticks = 2, labels = T, cex.axis = 1.2, las = 1,
     at = c(0, 10, 20, 30))
axis(side=2, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 10, 20, 30))
axis(side=3, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
```

```
axis(side=3, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=4, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(0, 10, 20, 30))
axis(side=4, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 10, 20, 30))
mtext(side = 2, expression(paste("DOC (mg C L" ^-1, ")", sep="")), line = 3.5, cex = 1)
legend("topleft", "A", bty = "n", x.intersp = 0, cex = 1.25)
box(lwd = 2)

# Total Nitrogen Plot
plot(TN$conc ~ TN$sample, ylim = c(0,0.65), las = 1,
     xaxt="n", xlab = "", yaxt="n", ylab = "")
axis(side=1, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=1, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=2, lwd.ticks = 2, labels = T, cex.axis = 1.2, las = 1,
     at = c(0.0, 0.2, 0.4, 0.6))
axis(side=2, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0.0, 0.2, 0.4, 0.6))
axis(side=3, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=3, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=4, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(0.0, 0.2, 0.4, 0.6))
axis(side=4, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0.0, 0.2, 0.4, 0.6))
mtext(side = 2, expression(paste("TN (mg N L" ^-1, ")")), line = 3.5, cex = 1)
legend("topleft", "B", bty = "n", x.intersp = 0, cex = 1.25)
box(lwd = 2)

# Total Phosphorus Plot
plot(TP$sample, TP$conc, ylim = c(0,50), las = 1,
     xaxt="n", xlab = "", yaxt="n", ylab = "")
axis(side=1, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=1, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=2, lwd.ticks = 2, labels = T, cex.axis = 1.2, las = 1,
     at = c(0, 20, 40))
axis(side=2, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 20, 40))
axis(side=3, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=3, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=4, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(0, 20, 40))
axis(side=4, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 20, 40))
mtext(side = 2, expression(paste("TP (",mu, "g P L" ^-1, ")")), line = 3.5, cex = 1)
mtext(side = 1, text = labs, line = 1, at = seq(1:10), padj = 0.5, cex = 0.8)
legend("topleft", "C", bty = "n", x.intersp = 0, cex = 1.25)
box(lwd = 2)

dev.off() # this writes plot to folder
graphics.off() # shuts down open devices
par(opar)
```

Chlorophyll a and Bacterial Respiration

```
chla <- read.delim("../data/ChlorophyllA.txt")
resp <- read.delim("../data/Respiration.txt")
```

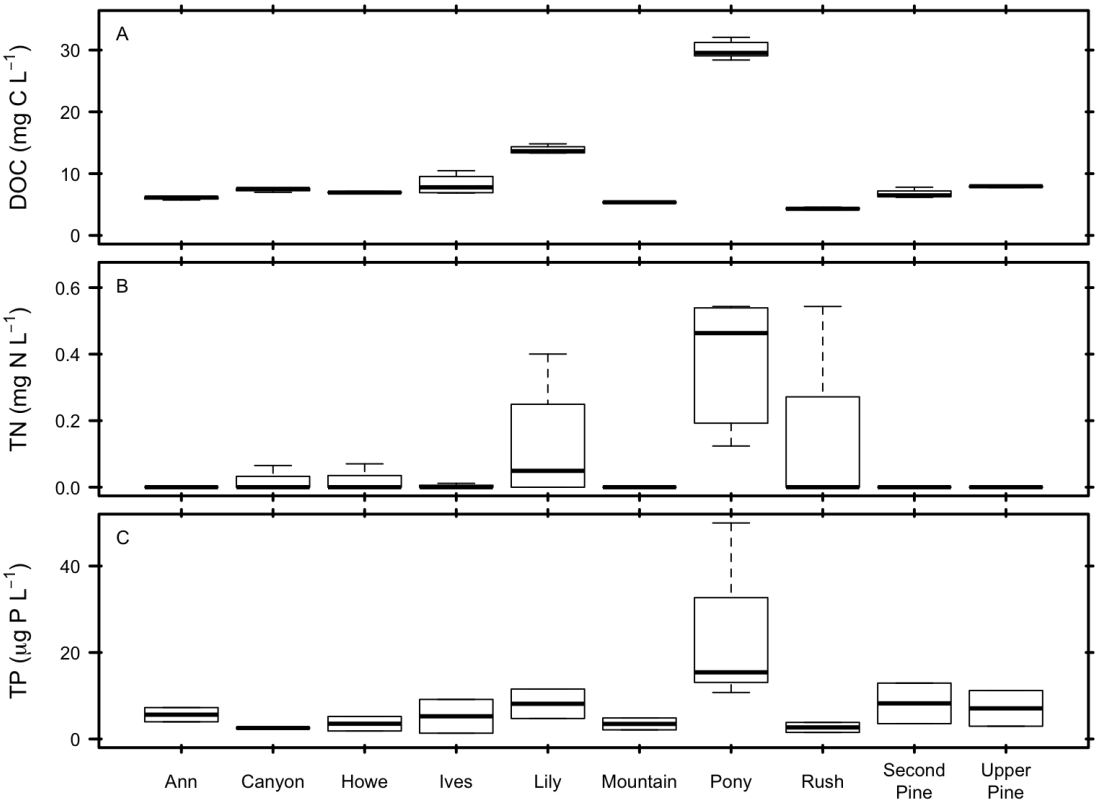


Figure 2: Lake Nutrients

Table 2: Chlorophyll a and BR

```
eco <- data.frame(matrix(NA, 10, 4))
row.names(eco) <- levels(chla$Lake)
colnames(eco) <- c("Chl11", "Chl12", "Resp11", "Resp12")
for (i in row.names(eco)){
  eco[i, 1] <- round(mean(chla[chla$Lake == i & chla$Year == "2011", 3]), 2)
  eco[i, 2] <- round(mean(chla[chla$Lake == i & chla$Year == "2012", 3]), 2)
  eco[i, 3] <- round(mean(resp[resp$sample == i & resp$year == "2011", 4]), 3)
  eco[i, 4] <- round(mean(resp[resp$sample == i & resp$year == "2012", 4]), 3)
}

addtorow <- list()
addtorow$pos <- list(0, 0)
addtorow$command <- c("& \\multicolumn{2}{c}{Chl a ($\\mu$g/L)} &
                      \\multicolumn{2}{c}{Resp. ($\\mu$ O2 Hr-1)} \\\\\n",
                      "Lake & 2011 & 2012 & 2011 & 2012 \\\\\n")
eco.tab <- xtable(eco)
align(eco.tab) <- "crrrr"
print(eco.tab, add.to.row = addtorow, include.colnames = FALSE,
      type= "latex", file="../tables/table2.tex", hline.after = c(-1, -1, 0, nrow(eco.tab)))
print(eco.tab, add.to.row = addtorow, include.colnames = FALSE, comment = FALSE, hline.after = c(-1, -1
```

	Chl a (μg/L)		Resp. (μ O2 Hr-1)	
Lake	2011	2012	2011	2012
Ann	1.31	1.25	1.96	1.00
Canyon	3.70	1.63	1.78	0.59
Howe	0.75	1.85	7.25	0.78
Ives	2.03	1.39	10.60	0.32
Lily	5.77	3.55	7.10	0.33
Mountain	1.80	2.14	8.31	0.99
Pony	24.58	16.35	9.81	1.46
Rush	0.65	1.23	10.40	0.76
SecondPine	2.13	3.76	6.27	0.98
UpperPine	2.14	8.55	6.22	1.09

Figure 2: Ecosystem

```
chla2 <- chla[chla$Year == "2012", ]
resp2 <- resp[resp$year == "2012", ]

png(filename="../figures/Figure2.png",
    width = 1600, height =1200, res = 96*2)
par(opar)
par(mfrow = c(1,1), mar = c(0, 6, 0, 0) + 0.5, oma = c(4, 0, 1, 1) + 0.5)
layout(rbind(1, 2), height = c(4, 4))

labs <- c("Ann", "Canyon", "Howe", "Ives", "Lily", "Mountain", "Pony", "Rush",
          "Second\nPine","Upper\nPine")
```

```
# ChlaA Plot 2012
plot(chla2$ChlA ~ chla2$Lake, ylim = c(0, 20), las = 1,
     xaxt="n", xlab = "", yaxt="n", ylab = "")
axis(side=1, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=1, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=2, lwd.ticks = 2, labels = T, cex.axis = 1.2, las = 1,
     at = c(0, 10, 20))
axis(side=2, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 10, 20, 30))
axis(side=3, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=3, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=4, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(0, 10, 20, 30))
axis(side=4, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 10, 20, 30))
mtext(side = 2, expression(paste("Chl a (mg C L" ^-1, ")", sep="")), line = 3.5, cex = 1)
legend("topleft", "A", bty = "n", x.intersp = 0, cex = 1.25)
box(lwd = 2)

# Bacterial Respiration
plot(resp2$rate ~ resp2$sample, ylim = c(0,2), las = 1,
     xaxt="n", xlab = "", yaxt="n", ylab = "")
axis(side=1, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=1, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=2, lwd.ticks = 2, labels = T, cex.axis = 1.2, las = 1,
     at = c(0, 1, 2))
axis(side=2, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 1, 2))
axis(side=3, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=3, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=4, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(0, 1, 2))
axis(side=4, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 1, 2))
mtext(side = 2, expression(paste("Resp. (", mu, "M O"[2], " Hr" ^-1, ")")), line = 3.5, cex = 1)
mtext(side = 1, text = labs, line = 1, at = seq(1:10), padj = 0.5, cex = 0.8)
legend("topleft", "B", bty = "n", x.intersp = 0, cex = 1.25)
box(lwd = 2)

dev.off() # this writes plot to folder
graphics.off() # shuts down open devices
par(opar)
```

Patterns of Bacterial Diversity

Import Raw Data

```
# Define Inputs
# Design = general design file for experiment
# shared = OTU table from mothur with sequence similarity clustering
# Taxonomy = Taxonomic information for each OTU
design.in <- "../data/design.txt"
shared <- "../data/HMWF.bac.final.shared"
taxon  <- "../data/HMWF.bac.final.0.03.taxonomy"
```

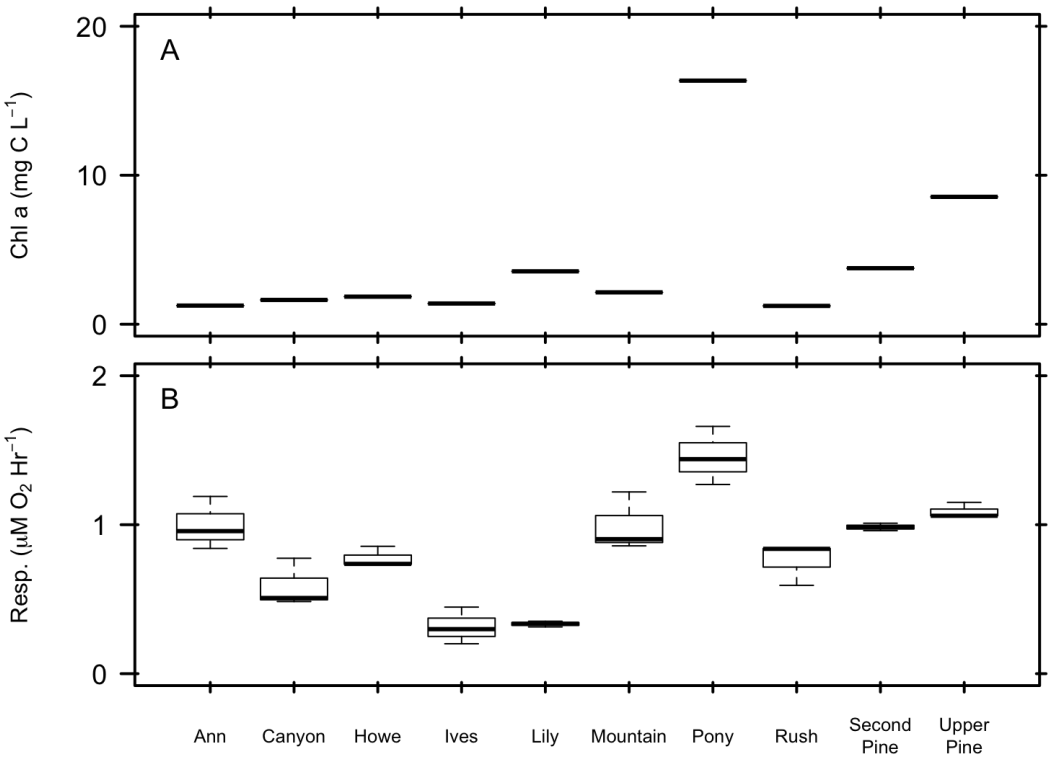


Figure 3: Ecosystem

```
# Import Design
design <- read.delim(design.in, header=T, row.names=1)

# Import Shared Files
OTUs.in <- read.otu(shared = shared, cutoff = "0.03")    # 97% Similarity

# Import Taxonomy
OTU.tax <- read.tax(taxonomy = taxon, format = "rdp")
```

Data Transformations

```
# Reorder Site
OTUs.hmwf <- OTUs.in[rownames(design), ]

# Remove OTUs with less than two occurences across all sites
OTUs <- OTUs.hmwf[, which(colSums(OTUs.hmwf) >= 2)]
# OTUs <- OTUs.hmwf[, colSums((OTUs.hmwf > 0) * 1)  >= 2 | colSums(OTUs.hmwf >= 10)]

# Sequencing Coverage
coverage <- rowSums(OTUs)

# Good's Coverage
goods <- function(x = ""){
  1 - (sum(x == 1) / rowSums(x))
}
goods.c <- goods(OTUs)

# Make Presence Absence Matrix
OTUsPA <- (OTUs > 0) * 1

# Make Relative Abundence Matrices
OTUsREL <- OTUs
for(i in 1:dim(OTUs)[1]){
  OTUsREL[i,] <- OTUs[i,]/sum(OTUs[i,])
}

# Log Transform Relative Abundances
OTUsREL.log <- decostand(OTUs, method="log")
```

Calculate Alpha Diversity

```
# Observed Richness
S.obs <- rowSums((OTUs > 0) * 1)

# Simpson's Evenness
SimpE <- function(x = ""){
  x <- as.data.frame(x)
  D <- diversity(x, "inv")
  S <- sum((x > 0) * 1)
```

```
  E <- (D)/S
  return(E)
}
simpsE <- round(apply(OTUs, 1, SimpE), 3)

# Shannon's Diversity
H <- function(x = ""){
  x <- x[x>0]
  H = 0
  for (n_i in x){
    p = n_i / sum(x)
    H = H - p*log(p)
  }
  return(H)
}

shan <- round(apply(OTUs, 1, H), 2)
shan2 <- diversity(OTUs, index = "shannon")

design <- droplevels(design)

alpha.div <- cbind(design, S.obs, simpsE, shan)
alpha.div <- alpha.div[order(alpha.div$Lake, alpha.div$Year, alpha.div$Molecule), ]
```

Figure 3: Lake Alpha Diversity

```
png(filename="../figures/Figure3.png",
    width = 1600, height = 1100, res = 96*2)
par(opar)
par(mfrow = c(1,1), mar = c(0, 6, 0, 0) + 0.5, oma = c(3, 0, 1, 1) + 0.5)
layout(rbind(1, 2), height = c(3, 3))

plot(alpha.div$S.obs ~ alpha.div$Lake,  ylim = c(0,5000), las = 1,
     xaxt="n", xlab = "", yaxt="n", ylab = "")
axis(side=1, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=1, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=2, lwd.ticks = 2, labels = T, cex.axis = 1, las = 1,
     at = c(1000, 3000, 5000))
axis(side=2, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1000, 3000, 5000, 7000))
axis(side=3, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=3, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=4, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1000, 3000, 5000, 7000))
axis(side=4, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1000, 3000, 5000, 7000))
mtext(side = 2, "Richness (S)", line = 4, cex = 1)
legend("topleft", "A", bty = "n", x.intersp = 0, cex = 1.25)
box(lwd = 2)

plot(alpha.div$simpsE ~ alpha.div$Lake, ylim = c(0,0.06), las = 1,
     xaxt="n", xlab = "", yaxt="n", ylab = "")
axis(side=1, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=1, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
```

```
axis(side=2, lwd.ticks = 2, labels = T, cex.axis = 1, las = 1,
     at = c(0, 0.02, 0.04, 0.06))
axis(side=2, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 0.02, 0.04, 0.06))
axis(side=3, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(1:10))
axis(side=3, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(1:10))
axis(side=4, lwd.ticks = 2, tck=-0.02, labels = F, cex.axis = 1, at = c(0, 0.02, 0.04, 0.06))
axis(side=4, lwd.ticks = 2, tck=0.01, labels = F, cex.axis = 1, at = c(0, 0.02, 0.04, 0.06))
mtext(side = 2, "Simpson's Eveness (E)", line = 4, cex = 1)
mtext(side = 1, text = labs, line = 0.5, at = seq(1:10), padj = 0.5, cex = 0.8)
legend("topleft", "B", bty = "n", x.intersp = 0, cex = 1.25)
box(lwd = 2)

dev.off() # this writes plot to folder
graphics.off() # shuts down open devices
par(opar)
```

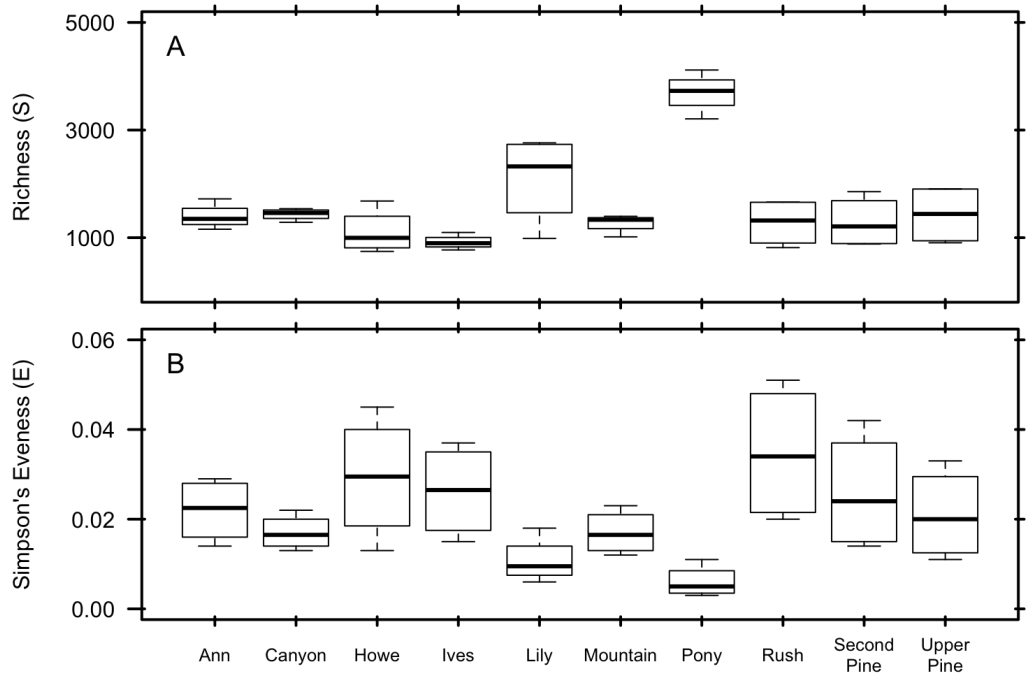


Figure 4: Lake Nutrients

Calculate and Visualize Beta Diversity

```
beta.w <- function(site1 = "", site2 = ""){
  site1 = subset(site1, select = site1 > 0)             # Removes absences
  site2 = subset(site2, select = site2 > 0)             # Removes absences
  gamma = union(colnames(site1), colnames(site2))       # Gamma species pool
  s     = length(gamma)                                 # Gamma richness
```

```
  a.bar = mean(c(specnumber(site1), specnumber(site2)))   # Mean sample richness
  b.w   = round(s/a.bar - 1, 3)
  return(b.w)
}

# Calculate Bray-Curtis
hmwf.db <- vegdist(OTUsREL.log, method = "bray")
```

Principal Coordinates Analysis

```
par(opar)
hmwf.pcoa <- cmdscale(hmwf.db, eig = TRUE, k = 3)
explainvar1 <- round(hmwf.pcoa$eig[1] / sum(hmwf.pcoa$eig), 3) * 100
explainvar2 <- round(hmwf.pcoa$eig[2] / sum(hmwf.pcoa$eig), 3) * 100
explainvar3 <- round(hmwf.pcoa$eig[3] / sum(hmwf.pcoa$eig), 3) * 100
sum.eig <- sum(explainvar1, explainvar2, explainvar3)

# Define Plot Parameters
par(mar = c(5, 5, 1, 2) + 0.1)

# Plot Eigenvalues
plot(hmwf.pcoa$eig, xlab = "PCoA Axis", ylab = "Eigenvalue",
     las = 1, cex.lab = 1.5, pch = 16)

# Add Expectation based on Kaiser-Guttman criterion and Broken Stick Model
abline(h = mean(hmwf.pcoa$eig), lty = 2, lwd = 2, col = "blue")
b.stick <- bstick(42, sum(hmwf.pcoa$eig))
lines(1:42, b.stick, type = "l", lty = 4, lwd = 2, col = "red")

# Add Legend
legend("topright", legend = c("Avg Eigenvalue", "Broken-Stick"),
       lty = c(2, 4), bty = "n", col = c("blue", "red"))
```

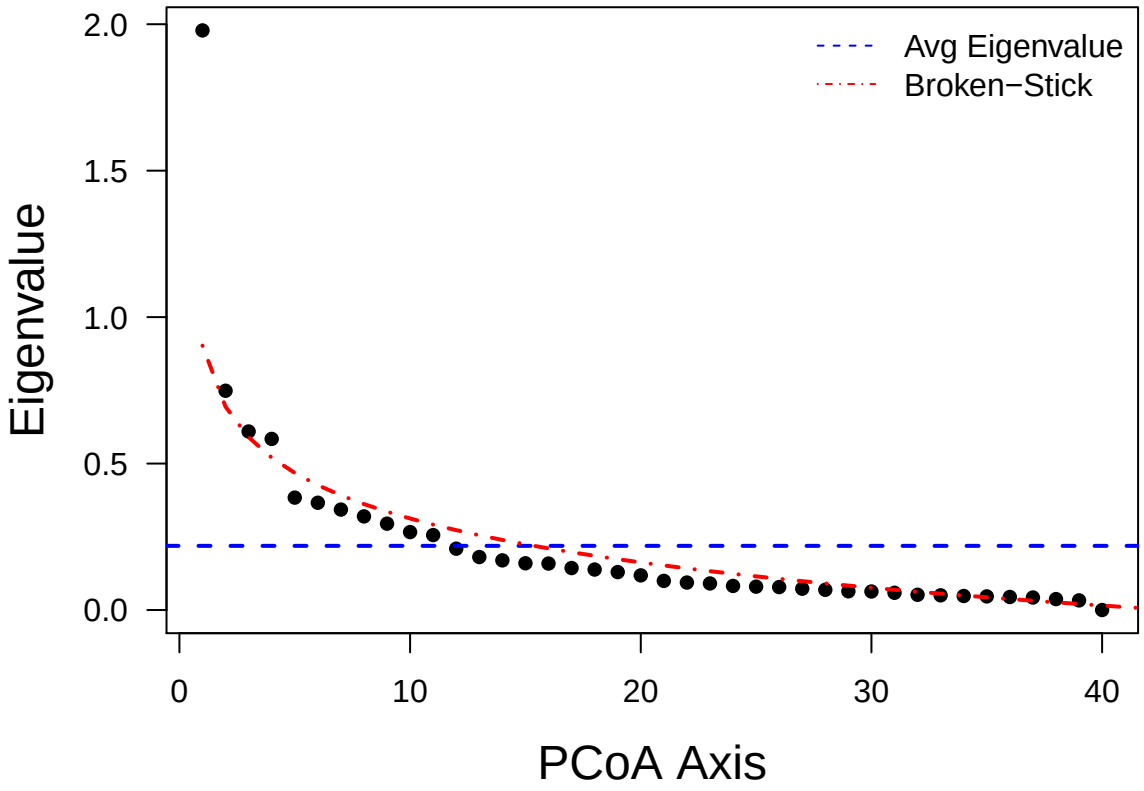


Figure 4: Bacterial Community Composition Ordination Figure

```
png(filename="../figures/Figure4.png",
    width = 1200, height = 1200, res = 96*2)
par(opar)
# Define Plot Parameters
par(mar = c(5, 5, 1, 1) + 0.1)

# Initiate Plot
plot(hmwf.pcoa$points[ ,1], hmwf.pcoa$points[ ,2],
     ylim = c(-0.3, 0.25), xlim = c(-0.3, 0.6),
     xlab = paste("PCoA 1 (", explainvar1, "%)", sep = ""),
     ylab = paste("PCoA 2 (", explainvar2, "%)", sep = ""),
     pch = 16, cex = 2.0, type = "n", cex.lab = 1.5, cex.axis = 1.2, axes = FALSE)

# Add Axes
axis(side = 1, labels = T, lwd.ticks = 2, cex.axis = 1, las = 1)
axis(side = 2, labels = T, lwd.ticks = 2, cex.axis = 1, las = 1)
abline(h = 0, v = 0, lty = 3)
box(lwd = 2)

# Add Points & Labels
points(hmwf.pcoa$points[ ,1], hmwf.pcoa$points[ ,2],
       pch = 19, cex = 3, bg = "gray", col = "gray")

ordiellipse(cbind(hmwf.pcoa$points[ ,1], hmwf.pcoa$points[ ,2]),
    design$Lake, kind="se", conf=0.95,
```

```
    lwd=2, draw = "polygon", col="gray", border = "black", label=TRUE, cex=1, bty = 'n')

dev.off() # this writes plot to folder
graphics.off() # shuts down open devices
par(opar)
```

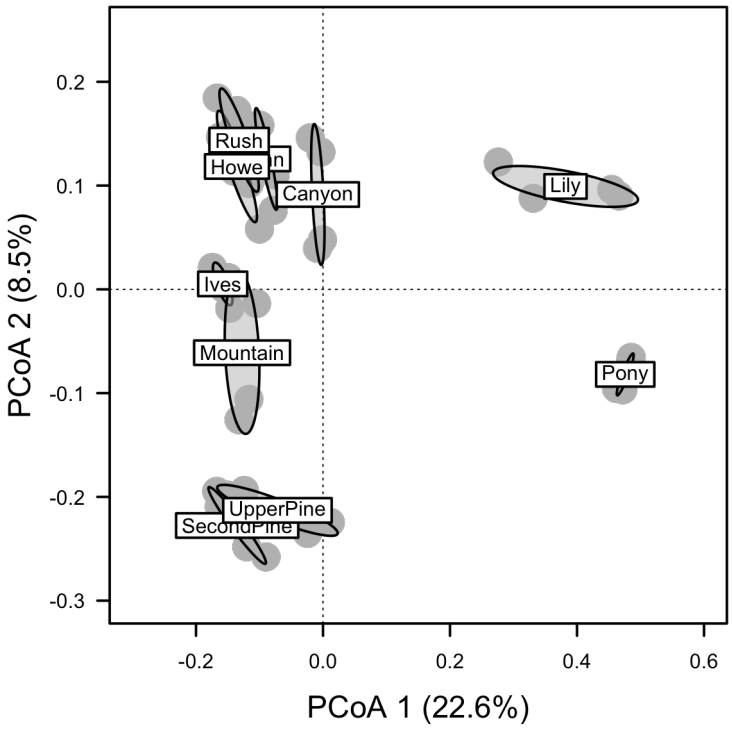


Figure 5: Lake Nutrients

Statistical Analyses

What are the differences between lakes and does resource concentration explain differences

```
nuts
```

```
##        sample year       DOC        TP          TN
## 1         Ann 2011  6.149285  3.977949 0.000000000
## 2      Canyon 2011  7.615331  2.452633 0.000000000
## 3        Howe 2011  6.875177  1.859455 0.035116957
## 4        Ives 2011  9.537734  1.351016 0.005848597
## 5        Lily 2011 13.358296  4.740607 0.249393025
## 6    Mountain 2011  5.411983  2.113674 0.000000000
## 8        Pony 2011 31.648222  1.520496 0.541116330
## 9        Rush 2011  4.437947  3.554250 0.271601973
## 10 SecondPine 2011  7.197479 10.757130 0.000000000
## 11  UpperPine 2011  7.990399  2.961072 0.000000000
## 12        Ann 2012  5.973806  7.267117 0.000000000
```

```
## 13     Canyon 2012  7.233826  2.638631 0.032606559
## 14       Howe 2012  7.037040  5.210013 0.000000000
## 15       Ives 2012  6.913681  9.152797 0.000000000
## 16       Lily 2012 14.351915 11.552753 0.000000000
## 17   Mountain 2012  5.270368  4.867162 0.000000000
## 18       Pony 2012 28.986069 49.952043 0.158174426
## 19       Rush 2012  4.223288  3.838609 0.000000000
## 20 SecondPine 2012  6.261643 12.924156 0.000000000
## 21  UpperPine 2012  7.840340 11.209902 0.000000000
```

```
nuts2 <- data.frame(nuts[rep(seq_len(nrow(nuts)), each=2),])
nuts2$molecule <- rep(c("DNA", "RNA"), 20)
nuts2 <- nuts2[order(nuts2$sample, nuts2$year, nuts2$molecule), ]
as.character(nuts2$sample) == as.character(design$Lake)
```

```
##  [1] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [15] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [29] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
```

```
beta.dis <- betadisper(vegdist(OTUsREL.log, "bray"), design$Lake)
permutest(beta.dis)
```

```
##
## 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     9 0.030122 0.0033469 3.6548    999  0.004 **
## Residuals 30 0.027473 0.0009158
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
adonis(OTUsREL.log ~ design$Lake + design$Molecule + design$Year, method = "bray", permutations = 999)
```

```
##
## Call:
## adonis(formula = OTUsREL.log ~ design$Lake + design$Molecule +      design$Year, permutations = 999,
##
## Permutation: free
## Number of permutations: 999
##
## Terms added sequentially (first to last)
##
##                 Df SumsOfSqs MeanSqs F.Model      R2 Pr(>F)
## design$Lake      9    5.0583 0.56203  5.3537 0.57726  0.001 ***
## design$Molecule  1    0.2868 0.28675  2.7315 0.03272  0.005 **
## design$Year      1    0.4781 0.47810  4.5542 0.05456  0.001 ***
## Residuals       28    2.9394 0.10498         0.33545
## Total           39    8.7626                 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
chem.dbrda <- capscale(OTUsREL.log ~ scale(log(nuts2$DOC)) + scale(log1p(nuts2$TN)) +
                         scale(log(nuts2$TP)), add = T, distance = "bray")
anova(chem.dbrda)
```

```
## Permutation test for capscale under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: capscale(formula = OTUsREL.log ~ scale(log(nuts2$DOC)) + scale(log1p(nuts2$TN)) + scale(log(nu
##          Df SumOfSqs      F Pr(>F)
## Model     3   2.3631 4.4313  0.001 ***
## Residual 36   6.3994
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
RsquareAdj(chem.dbrda)
```

```
## $r.squared
## [1] 0.2696859
##
## $adj.r.squared
## [1] 0.2088264
```

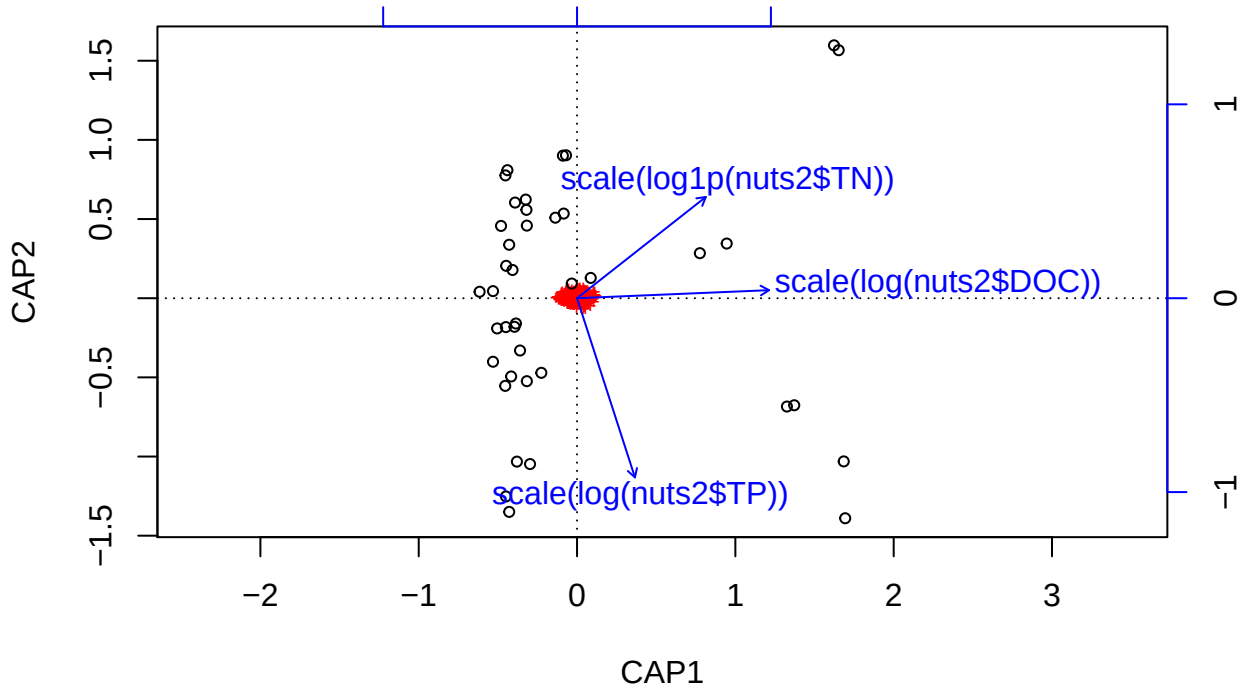
```r
coef(chem.dbrda)
```

```
##                              CAP1          CAP2       CAP3
## scale(log(nuts2$DOC))  0.13876443  0.0005170804  0.1727700
## scale(log1p(nuts2$TN)) 0.02500179  0.0615073292 -0.2082329
## scale(log(nuts2$TP))   0.02034276 -0.1384596276 -0.1098760
```

```r
anova.cca(chem.dbrda, step=1000)
```

```
## Permutation test for capscale under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: capscale(formula = OTUsREL.log ~ scale(log(nuts2$DOC)) + scale(log1p(nuts2$TN)) + scale(log(nu
##          Df SumOfSqs      F Pr(>F)
## Model     3   2.3631 4.4313  0.001 ***
## Residual 36   6.3994
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
plot(chem.dbrda)
```




```
lmod <- as.mlm(chem.dbrda)
# influence.measures(lmod)
lmod
```

```
##
## Call:
## lm(formula = x$CCA$wa ~ . - 1, data = as.data.frame(X))
##
## Coefficients:
##                             CAP1        CAP2        CAP3
## `scale(log(nuts2$DOC))`    0.1387644   0.0005171   0.1727700
## `scale(log1p(nuts2$TN))`   0.0250018   0.0615073  -0.2082329
## `scale(log(nuts2$TP))`     0.0203428  -0.1384596  -0.1098760
```

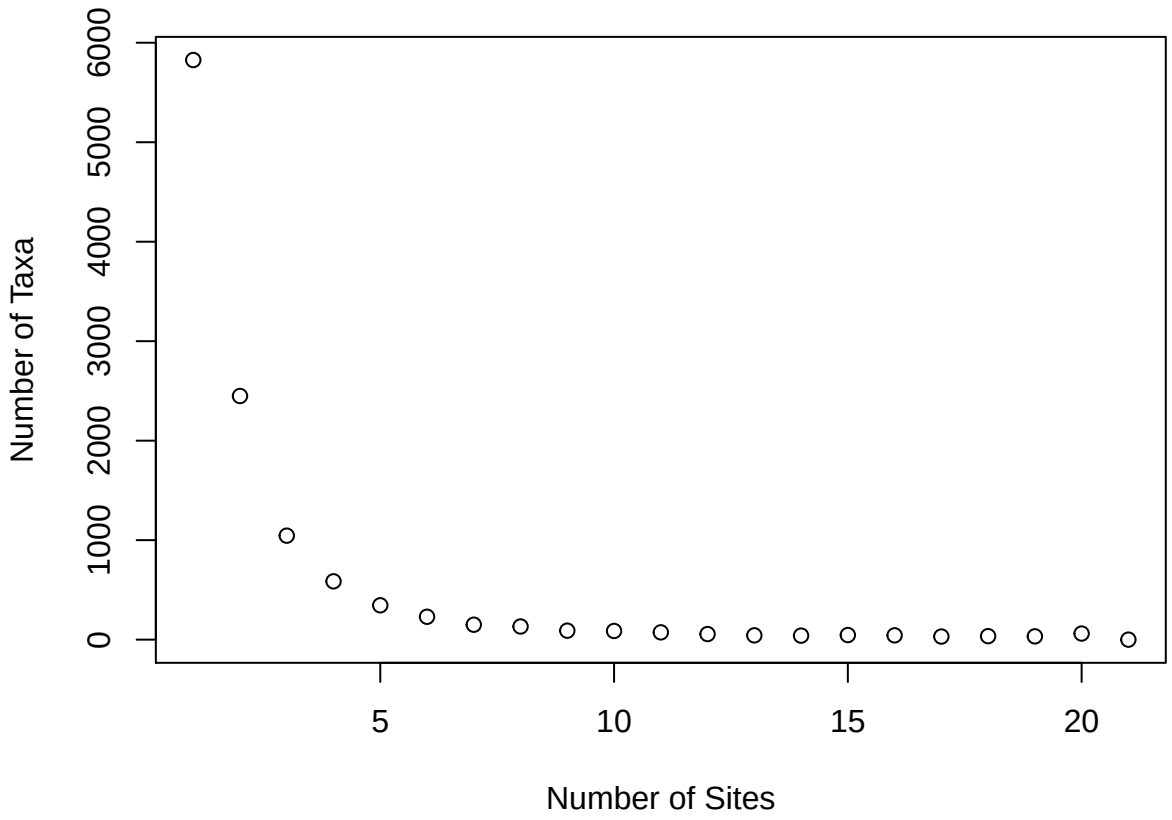
```
summary(lmod)
```

```
## Response CAP1 :
##
## Call:
## lm(formula = CAP1 ~ (`scale(log(nuts2$DOC))` + `scale(log1p(nuts2$TN))` +
##     `scale(log(nuts2$TP))`) - 1, data = as.data.frame(X))
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.111404 -0.042477 -0.000619  0.030244  0.164474
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## `scale(log(nuts2$DOC))`    0.13876    0.01309  10.597 9.21e-13 ***
## `scale(log1p(nuts2$TN))`   0.02500    0.01291   1.936   0.0605 .
```

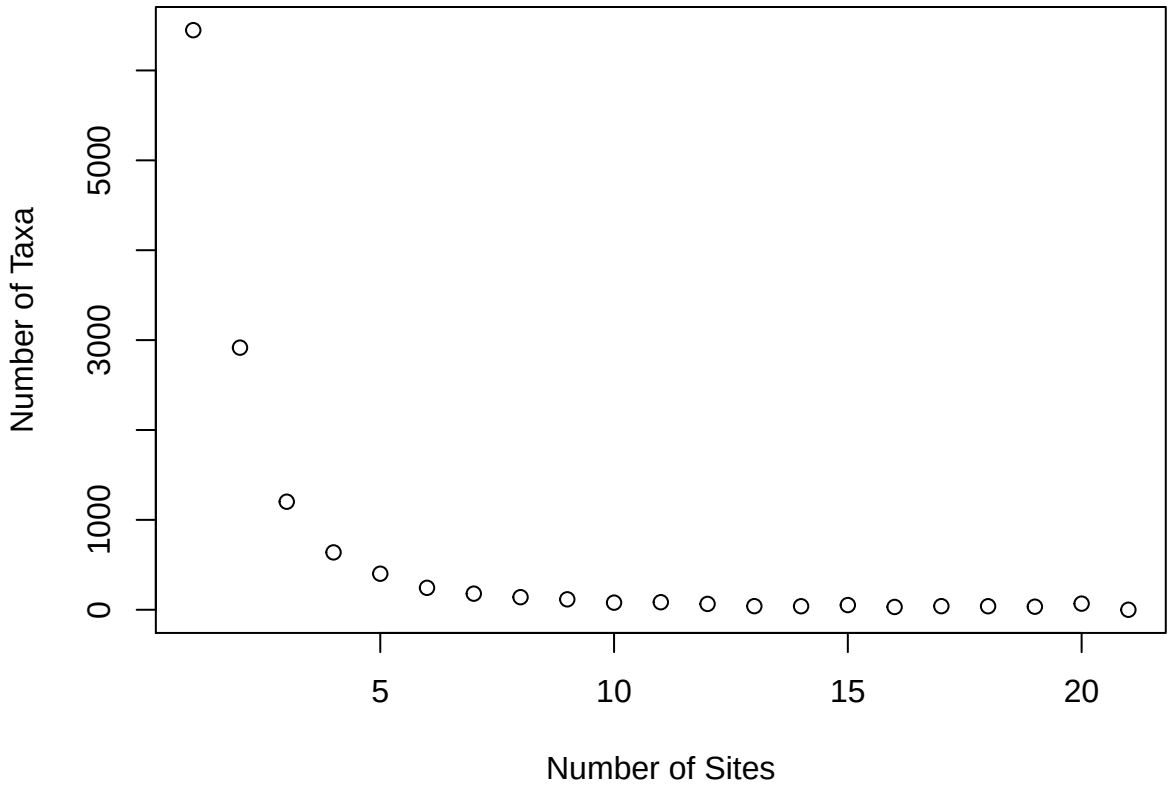
```
## `scale(log(nuts2$TP))`    0.02034    0.01051   1.935   0.0607 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.05909 on 37 degrees of freedom
## Multiple R-squared:  0.8856, Adjusted R-squared:  0.8763
## F-statistic: 95.47 on 3 and 37 DF,  p-value: < 2.2e-16
##
##
## Response CAP2 :
##
## Call:
## lm(formula = CAP2 ~ (`scale(log(nuts2$DOC))` + `scale(log1p(nuts2$TN))` +
##     `scale(log(nuts2$TP))`) - 1, data = as.data.frame(X))
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.129766 -0.039095 -0.000821  0.034952  0.130825
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## `scale(log(nuts2$DOC))`   0.0005171  0.0140802   0.037    0.971
## `scale(log1p(nuts2$TN))`  0.0615073  0.0138873   4.429 8.10e-05 ***
## `scale(log(nuts2$TP))`   -0.1384596  0.0113054 -12.247 1.39e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.06354 on 37 degrees of freedom
## Multiple R-squared:   0.87,  Adjusted R-squared:  0.8595
## F-statistic: 82.56 on 3 and 37 DF,  p-value: < 2.2e-16
##
##
## Response CAP3 :
##
## Call:
## lm(formula = CAP3 ~ (`scale(log(nuts2$DOC))` + `scale(log1p(nuts2$TN))` +
##     `scale(log(nuts2$TP))`) - 1, data = as.data.frame(X))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.19499 -0.05264  0.02351  0.05094  0.10832
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## `scale(log(nuts2$DOC))`    0.17277    0.01589  10.876 4.43e-13 ***
## `scale(log1p(nuts2$TN))` -0.20823    0.01567 -13.290 1.17e-15 ***
## `scale(log(nuts2$TP))`   -0.10988    0.01276  -8.614 2.27e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.07169 on 37 degrees of freedom
## Multiple R-squared:  0.8402, Adjusted R-squared:  0.8273
## F-statistic: 64.86 on 3 and 37 DF,  p-value: 8.39e-15
```

Generalists

```
active <- OTUs[design$Molecule == "RNA", ]
activePA <- (active > 0) * 1

total <- OTUs[design$Molecule == "DNA", ]
totalPA <- (total > 0) * 1

gens <- data.frame(matrix(NA, 21, 3))
colnames(gens) <- c("sites", "taxaA", "taxaT")
gens$sites <- c(1:21)

for (i in 1:21){
  gens$taxaA[i] <- sum(colSums(activePA) == i)
  gens$taxaT[i] <- sum(colSums(totalPA) == i)
}

# Define Plot Parameters
par(mar = c(5, 5, 1, 1) + 0.1)
plot(gens$taxaA ~ gens$sites, xlab = "Number of Sites", ylab = "Number of Taxa")
```



```
plot(gens$taxaT ~ gens$sites, xlab = "Number of Sites", ylab = "Number of Taxa")
```




```
# Total Taxa
total <- OTUs[design$Molecule == "DNA", ]
totalPA <- (total > 0) * 1

# Inactive Taxa
inactivePA <- totalPA - activePA
inactivePA <- pmax(inactivePA, 0)
sum(colSums(inactivePA)  > 10)
```

```
## [1] 9
```

```
rowSums(inactivePA)/rowSums(totalPA)
```

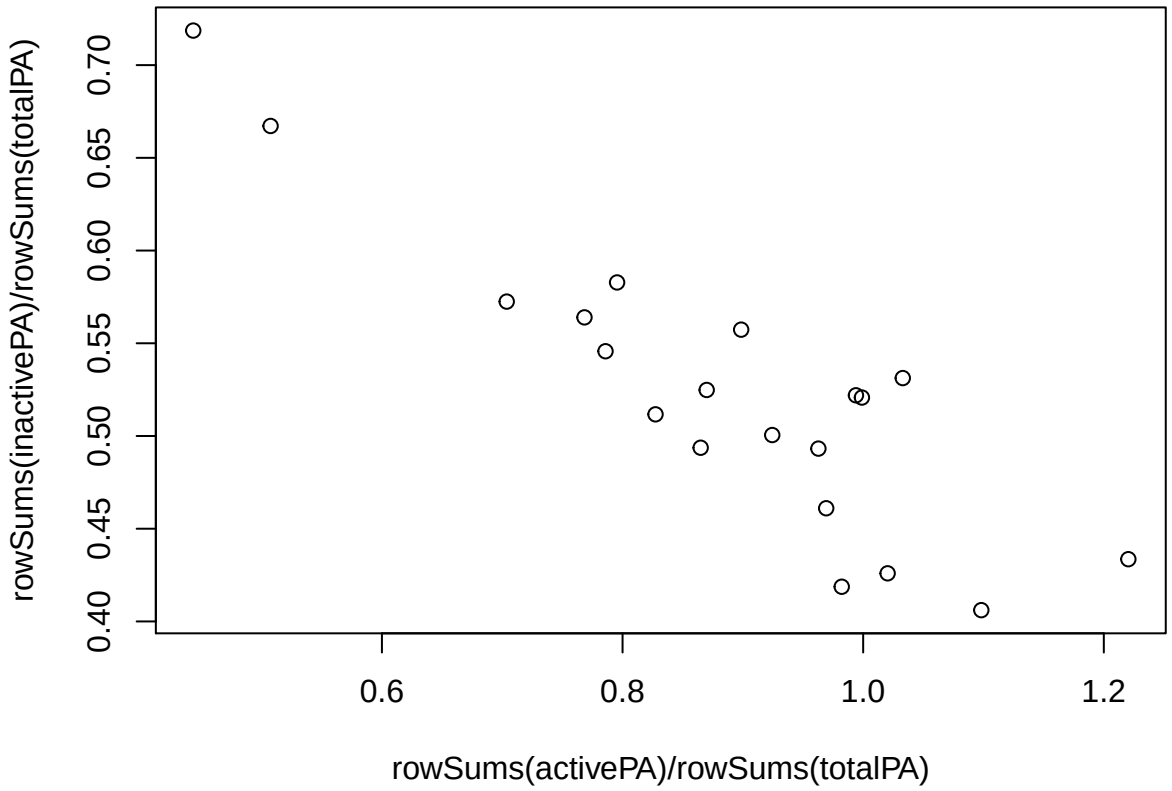
```
##         Ann2011_DNA         Ann2012_DNA      Canyon2011_DNA
##           0.5828007           0.5248120           0.5312290
##      Canyon2012_DNA        Howe2011_DNA        Howe2012_DNA
##           0.5573427           0.7186199           0.5456989
##        Ives2011_DNA        Ives2012_DNA        Lily2011_DNA
##           0.5724704           0.4610318           0.6671819
##        Lily2012_DNA    Mountain2011_DNA    Mountain2012_DNA
##           0.4259328           0.4931997           0.5639667
##        Pony2011_DNA        Pony2012_DNA        Rush2011_DNA
##           0.4936641           0.4060832           0.5219483
##        Rush2012_DNA  SecondPine2011_DNA  SecondPine2012_DNA
```

```
##          0.5116751          0.4335526          0.4187082
##  UpperPine2011_DNA  UpperPine2012_DNA
##          0.5207349          0.5005107
```

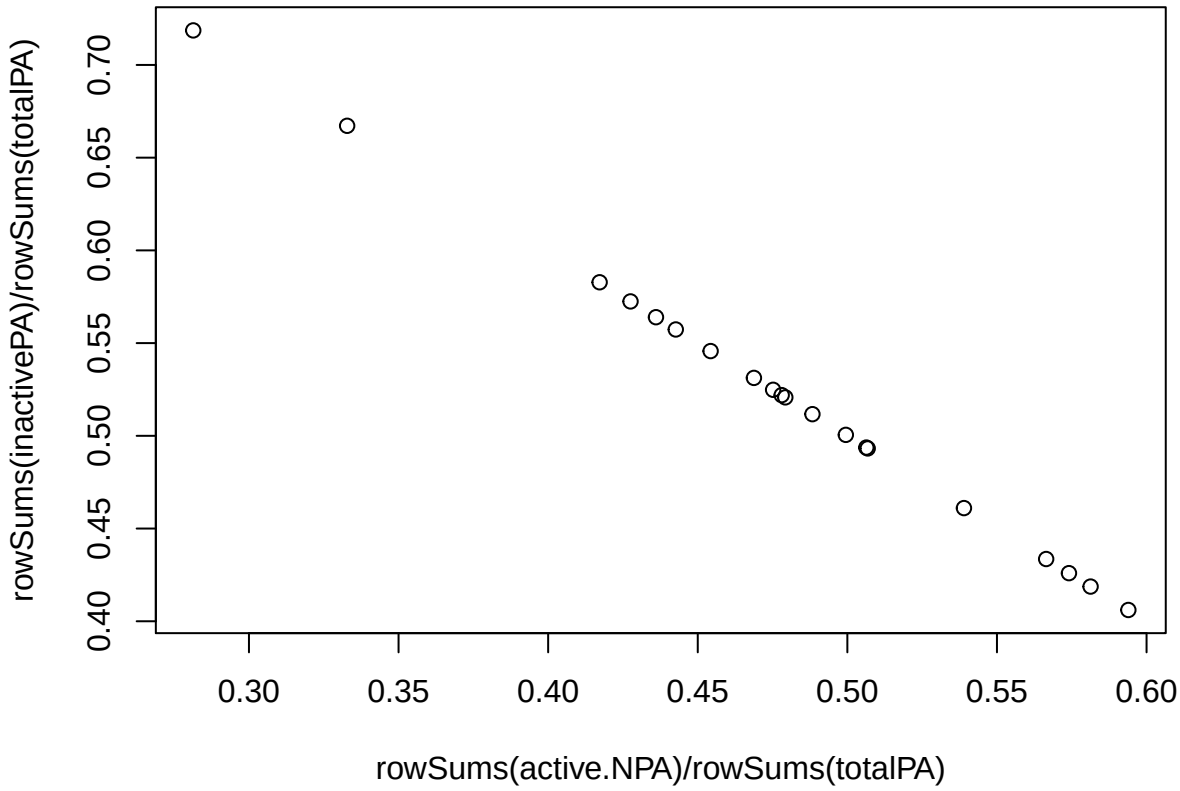
```
rowSums(activePA)/rowSums(totalPA)
```

```
##        Ann2011_RNA        Ann2012_RNA     Canyon2011_RNA
##          0.7954678          0.8699248          1.0329080
##     Canyon2012_RNA       Howe2011_RNA       Howe2012_RNA
##          0.8986014          0.4431886          0.7858423
##       Ives2011_RNA       Ives2012_RNA       Lily2011_RNA
##          0.7037375          0.9692645          0.5074704
##       Lily2012_RNA   Mountain2011_RNA   Mountain2012_RNA
##          1.0203177          0.9627774          0.7683573
##       Pony2011_RNA       Pony2012_RNA       Rush2011_RNA
##          0.8649232          1.0981857          0.9939868
##       Rush2012_RNA SecondPine2011_RNA SecondPine2012_RNA
##          0.8274112          1.2203947          0.9821826
##  UpperPine2011_RNA  UpperPine2012_RNA
##          0.9989501          0.9244127
```

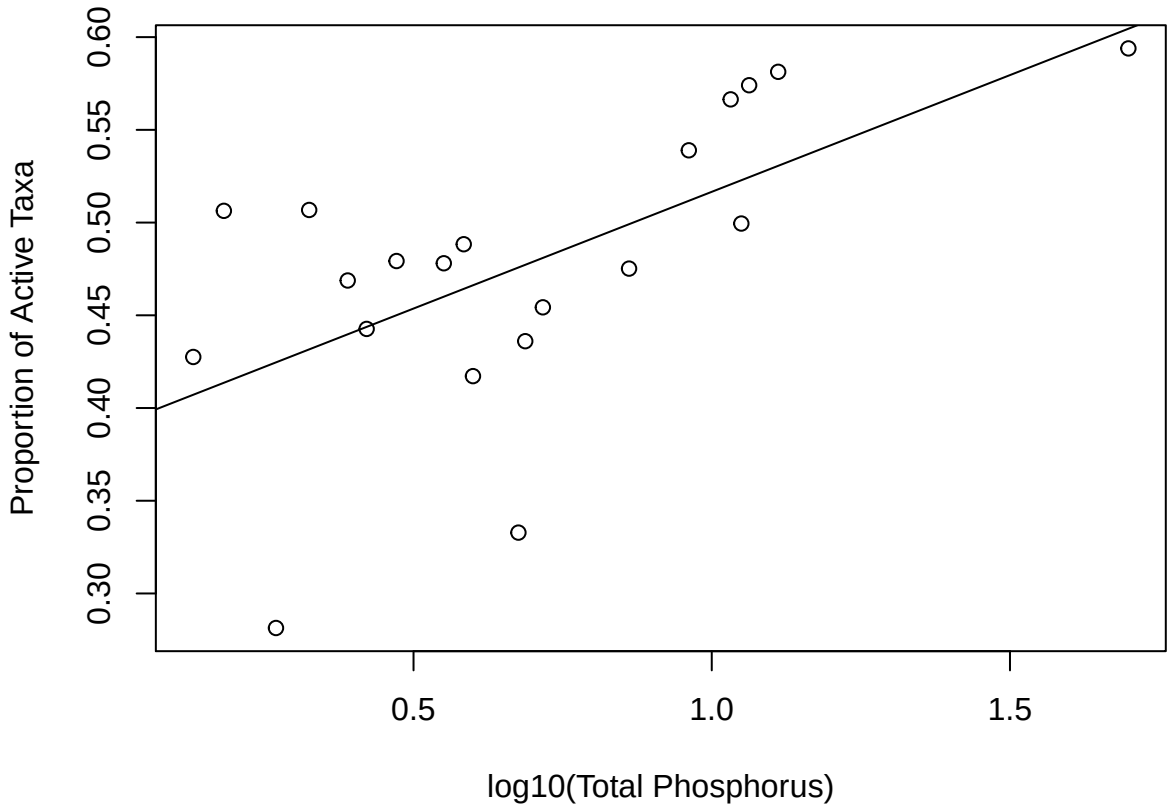
```
plot(rowSums(activePA)/rowSums(totalPA), rowSums(inactivePA)/rowSums(totalPA))
```




```
inactive <- total * inactivePA
active.N <- total * (1-inactivePA)
active.NPA <- (active.N > 0 ) * 1

plot(rowSums(active.NPA)/rowSums(totalPA), rowSums(inactivePA)/rowSums(totalPA))
```




```
plot(rowSums(active.NPA)/rowSums(totalPA) ~ log10(nuts2$TP[nuts2$molecule == "DNA"]),
     xlab = "log10(Total Phosphorus)", ylab = "Proportion of Active Taxa")
phos <- lm(rowSums(active.NPA)/rowSums(totalPA) ~ log10(nuts2$TP[nuts2$molecule == "DNA"]))
abline(phos)
```




```
dim(activePA)
```

```
## [1]    20 15997
```

```
dim(totalPA)
```

```
## [1]    20 15997
```

Patterns of Resource Diversity

```
# Define Inputs
# Resource = raw site-by-resource matrix
resource.pos <- "../data/SpecAbundAvePos.csv"
resource.neg <- "../data/SpecAbundAveNeg.csv"

# Import Resources
res.in <- read.csv(resource.neg, header=T, row.names=1)

rownames(res.in)
```

```
##  [1] "Ann_Lake-5.1906"      "blank-5.7312"         "Canyon_Chemo-NA"
##  [4] "Canyon_Epi-8.0847"    "Canyon_Hypo-5.2494"   "Canyon_I-8.72"
##  [7] "Canyon_II-5.4808"     "Canyon_III-7.392"     "Canyon_IV-5.41395"
## [10] "Cowe_Lake-5.39"       "Ives_Lake-7.512"      "Jordan_River-0"
```

```
## [13] "Lily_Pond-7.6638"     "Mountain_lake-12.915" "Pony_Lake-8.9376"
## [16] "Rush-16.299"          "Second_Pine-9.0368"   "Upper_Pine-13.9104"
```

```
rownames(res.in) <- c("Ann", "blank", "CanyonChemo", "Canyon", "CanyonHypo",
                      "CanyonI", "CanyonII", "CanyonIII", "CanyonIV", "Howe",
                      "Ives", "Jordan", "Lily", "Mountain", "Pony", "Rush",
                      "SecondPine", "UpperPine")

blank <- unlist(res.in["blank", ])
res.hmwf <- res.in[-c(which(rownames(res.in) %in% c("blank", "CanyonChemo",
                           "CanyonHypo", "CanyonI", "CanyonII",
                           "CanyonIII", "CanyonIV", "Jordan"))), ]
```

Remove Major Peaks from Blanks

```
summary(blank)
```

```
##      Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
##     21.25    641.80   1744.00   2729.00   3106.00 151500.00
```

```
blank[which(blank > 2 * sd(blank))]
```

```
##        C2        C5       C31       C83      C123      C124      C179
##  22847.63  92992.79 151455.84  38813.41  19059.45  24546.52  19593.59
##      C182      C185      C272      C273      C282      C284      C482
##  37004.20  16470.29  32986.92  16930.44  13222.98  56068.87  16735.12
##      C486      C487      C488      C489
##  17168.74  13282.27  29717.08  23246.62
```

```
# res.hmwf <- res.hmwf[, -c(which(blank > sd(blank)))]

# What other peaks should be removed
for (i in 1:dim(res.hmwf)[1]){
  res.hmwf[i, ] <- res.hmwf[i, ] - blank * 1.1
}

res.hmwf[res.hmwf < 50] <- 0
res.hmwf <- res.hmwf[,colSums(res.hmwf) > 0]
```

Data Transformations

```
# Remove OTUs with less than two occurences across all sites
res <- res.hmwf

# Sequencing Coverage
coverage <- rowSums(res)

# # Remove Low Coverage Samples (This code removes two sites: Site 5DNA, Site 6cDNA)
```

```
# lows <- which(coverage < 10000)
# OTUs <- OTUs[-which(coverage < 10000), ]
# design <- design[-which(coverage < 10000), ]

# Make Relative Abundence Matrices
resREL <- res
for(i in 1:dim(res)[1]){
  resREL[i,] <- res[i,]/sum(res[i,])
}

# Log Transform Relative Resource Abundance
resREL.log <- decostand(resREL, method="log")
```

```
## Warning: non-integer data: divided by smallest positive value
```

Calculate Alpha Diversity

```
# Observed Richness
S.res <- rowSums((res > 0) * 1)

# Simpson's Evenness
res.simpsE <- round(apply(res, 1, SimpE), 3)

# Shannon's Diversity
res.shan <- round(apply(res, 1, H), 2)
res.shan2 <- round(diversity(res, index = "shannon"), 2)

res.div <- as.data.frame(cbind(S.res, res.simpsE, res.shan2))
```

Figure 5: Resource Diversity

```
png(filename="../figures/Figure5.png",
    width = 1600, height = 1200, res = 96*2)
par(opar)
par(mfrow = c(1,1), mar = c(0, 9, 0, 0) + 0.5, oma = c(5, 0, 1, 1) + 0.5)
layout(rbind(1, 2, 3), height = c(3, 3, 3))
labs <- c("Ann", "Canyon", "Howe", "Ives", "Lily", "Mountain", "Pony", "Rush",
          "Second\nPine","Upper\nPine")
rich <- barplot(res.div$S.res, names.arg = NULL, las =1, ylim=c(0, 750),
     xlab = "", ylab = "")
mtext(side = 2, text = "Resource\nRichness", cex.lab = 1.2, line = 4.5)
even <- barplot(res.div$res.simpsE, names.arg = NULL, las =1, ylim=c(0, 0.27),
     xlab = "", ylab = "")
mtext(side = 2, text = "Simpson's\nEvenness", cex.lab = 1.2, line = 4.5)
shan <- barplot(res.div$res.shan, names.arg = NULL, las = 1, ylim = c(0, 9),
     xlab = "", ylab = "")
mtext(side = 2, text = "Shannon\nDiversity", cex.lab = 1.2, line = 4.5)
mtext(side = 1, text = labs, line = 2, at = shan, padj = 0.5, cex = 0.8)
```

```
dev.off() # this writes plot to folder
graphics.off() # shuts down open devices
par(opar)
```

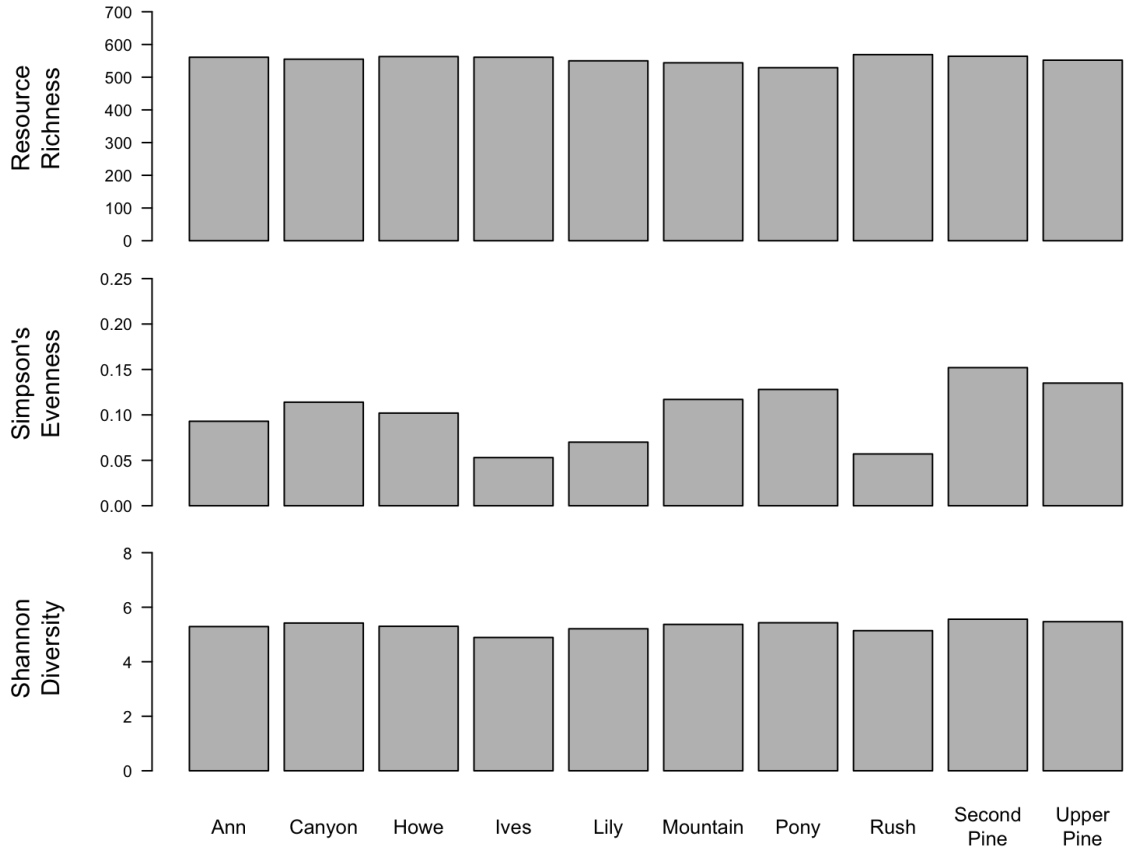


Figure 6: Resource Alpha Diversity

Hypothesis that resource diversity is related to nutrient concentration

```
nuts2012 <- nuts2[nuts2$year == "2012" & nuts2$molecule == "DNA", ]
evenmod <- lm(res.div$res.simpsE ~ nuts2012$DOC*nuts2012$TN*nuts2012$TP)
richmod <- lm(res.div$S.res ~ nuts2012$DOC*nuts2012$TN*nuts2012$TP)
summary(evenmod)
```

```
##
## Call:
## lm(formula = res.div$res.simpsE ~ nuts2012$DOC * nuts2012$TN *
##     nuts2012$TP)
##
## Residuals:
##          1          2          3          4          5          6
```

```
## -8.380e-03 -9.975e-18  1.229e-02 -5.751e-02 -2.712e-04  3.338e-02
##          7          8          9         10
##  7.585e-20 -1.461e-02  1.544e-02  1.967e-02
##
## Coefficients: (2 not defined because of singularities)
##                                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)                        -0.003428   0.165120  -0.021    0.984
## nuts2012$DOC                        0.009416   0.029765   0.316    0.768
## nuts2012$TN                        -0.972938   6.987466  -0.139    0.896
## nuts2012$TP                         0.015238   0.015310   0.995    0.376
## nuts2012$DOC:nuts2012$TN            0.289010   0.759128   0.381    0.723
## nuts2012$DOC:nuts2012$TP           -0.001432   0.002631  -0.544    0.615
## nuts2012$TN:nuts2012$TP                  NA         NA      NA       NA
## nuts2012$DOC:nuts2012$TN:nuts2012$TP     NA         NA      NA       NA
##
## Residual standard error: 0.03702 on 4 degrees of freedom
## Multiple R-squared:  0.4608, Adjusted R-squared:  -0.2133
## F-statistic: 0.6836 on 5 and 4 DF,  p-value: 0.6616
```

```
summary(richmod)
```

```
##
## Call:
## lm(formula = res.div$S.res ~ nuts2012$DOC * nuts2012$TN * nuts2012$TP)
##
## Residuals:
##          1          2          3          4          5          6
##  1.577e+00 -2.554e-15  5.592e+00  2.294e+00  6.734e-01 -1.566e+01
##          7          8          9         10
##  8.503e-18  8.247e+00  3.324e+00 -6.044e+00
##
## Coefficients: (2 not defined because of singularities)
##                                       Estimate Std. Error t value
## (Intercept)                          5.652e+02  4.463e+01  12.664
## nuts2012$DOC                        -1.316e+00  8.045e+00  -0.164
## nuts2012$TN                         -3.912e+01  1.889e+03  -0.021
## nuts2012$TP                          3.100e-01  4.138e+00   0.075
## nuts2012$DOC:nuts2012$TN            -5.684e-01  2.052e+02  -0.003
## nuts2012$DOC:nuts2012$TP            -3.257e-03  7.112e-01  -0.005
## nuts2012$TN:nuts2012$TP                    NA         NA      NA
## nuts2012$DOC:nuts2012$TN:nuts2012$TP       NA         NA      NA
##                                     Pr(>|t|)
## (Intercept)                         0.000224 ***
## nuts2012$DOC                        0.877983
## nuts2012$TN                         0.984467
## nuts2012$TP                         0.943885
## nuts2012$DOC:nuts2012$TN            0.997922
## nuts2012$DOC:nuts2012$TP            0.996565
## nuts2012$TN:nuts2012$TP                   NA
## nuts2012$DOC:nuts2012$TN:nuts2012$TP      NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10 on 4 degrees of freedom
```

```
## Multiple R-squared:  0.678,  Adjusted R-squared:  0.2756
## F-statistic: 1.685 on 5 and 4 DF,  p-value: 0.3167
```

```
evenmod <- lm(res.div$res.simpsE ~ log(nuts2012$DOC))
richmod <- lm(res.div$S.res ~ log(nuts2012$DOC))
summary(evenmod)
```

```
##
## Call:
## lm(formula = res.div$res.simpsE ~ log(nuts2012$DOC))
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.047506 -0.029684  0.005882  0.018026  0.052670
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        0.07755    0.04479   1.732    0.122
## log(nuts2012$DOC)  0.01187    0.02099   0.566    0.587
##
## Residual standard error: 0.03495 on 8 degrees of freedom
## Multiple R-squared:  0.03845,    Adjusted R-squared:  -0.08174
## F-statistic: 0.3199 on 1 and 8 DF,  p-value: 0.5872
```

```
summary(richmod)
```

```
##
## Call:
## lm(formula = res.div$S.res ~ log(nuts2012$DOC))
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -17.612  -2.531   2.580   4.893   6.242
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        589.520      9.733  60.566 6.14e-12 ***
## log(nuts2012$DOC)  -16.791      4.562  -3.681  0.00621 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.597 on 8 degrees of freedom
## Multiple R-squared:  0.6288, Adjusted R-squared:  0.5824
## F-statistic: 13.55 on 1 and 8 DF,  p-value: 0.00621
```

```
xtable(summary(evenmod))
```

```
## % latex table generated in R 3.2.3 by xtable 1.8-0 package
## % Fri Jan 29 12:24:14 2016
## \begin{table}[ht]
## \centering
## \begin{tabular}{rrrrr}
```

```
##   \hline
##  & Estimate & Std. Error & t value & Pr($>$$|$t$|$) \\
##   \hline
## (Intercept) & 0.0776 & 0.0448 & 1.73 & 0.1216 \\
##   log(nuts2012\$DOC) & 0.0119 & 0.0210 & 0.57 & 0.5872 \\
##    \hline
## \end{tabular}
## \end{table}
```

Hypothesis that resource diversity influences consumer diversity

```
alpha.div2012 <- alpha.div[alpha.div$Year == "2012" & alpha.div$Molecule == "RNA", c(1, 4:6)]
rownames(alpha.div2012) <- alpha.div2012[, 1]
alpha.div2012 <- alpha.div2012[, -1]
rownames(res.div) == rownames(alpha.div2012)
```

```
##  [1] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
```

```
cor(res.div, alpha.div2012)
```

```
##                  S.obs     simpsE        shan
## S.res      -0.80387619  0.8511172 -0.01622849
## res.simpsE  0.09482115 -0.1131829  0.17618427
## res.shan2   0.14392964 -0.1783802  0.12036078
```

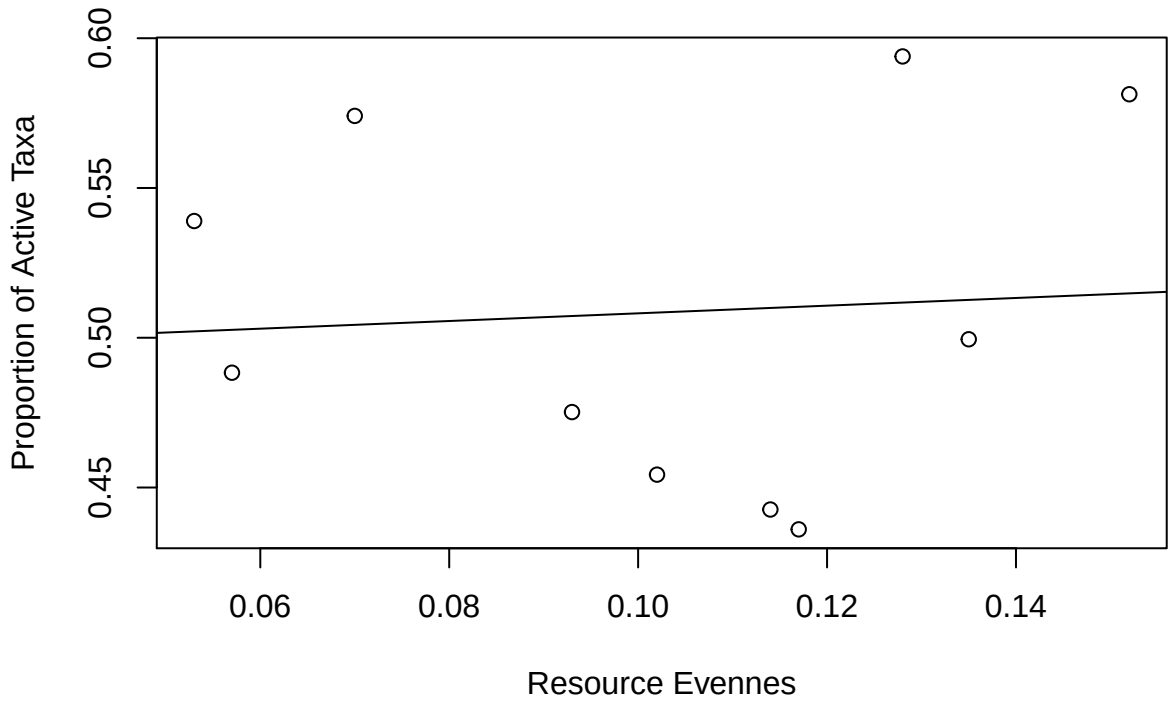
```
rich.mod1 <- lm(alpha.div2012$S.obs ~ res.div$S.res)
rich.mod2 <- lm(alpha.div2012$S.obs ~ res.div$res.simpsE)
summary(rich.mod1)
```

```
##
## Call:
## lm(formula = alpha.div2012$S.obs ~ res.div$S.res)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1263.77  -157.85    61.55   344.75   932.71
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   43031.79   10874.75   3.957  0.00419 **
## res.div$S.res   -74.91      19.60  -3.823  0.00507 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 691.1 on 8 degrees of freedom
## Multiple R-squared:  0.6462, Adjusted R-squared:  0.602
## F-statistic: 14.61 on 1 and 8 DF,  p-value: 0.005071
```

```r
summary(rich.mod2)
```

```
##
## Call:
## lm(formula = alpha.div2012$S.obs ~ res.div$res.simpsE)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -741.9 -573.1 -467.9 -237.2 2566.2
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)             1154       1227   0.941    0.374
## res.div$res.simpsE      3091      11472   0.269    0.794
##
## Residual standard error: 1157 on 8 degrees of freedom
## Multiple R-squared:  0.008991,   Adjusted R-squared:  -0.1149
## F-statistic: 0.07258 on 1 and 8 DF,  p-value: 0.7944
```

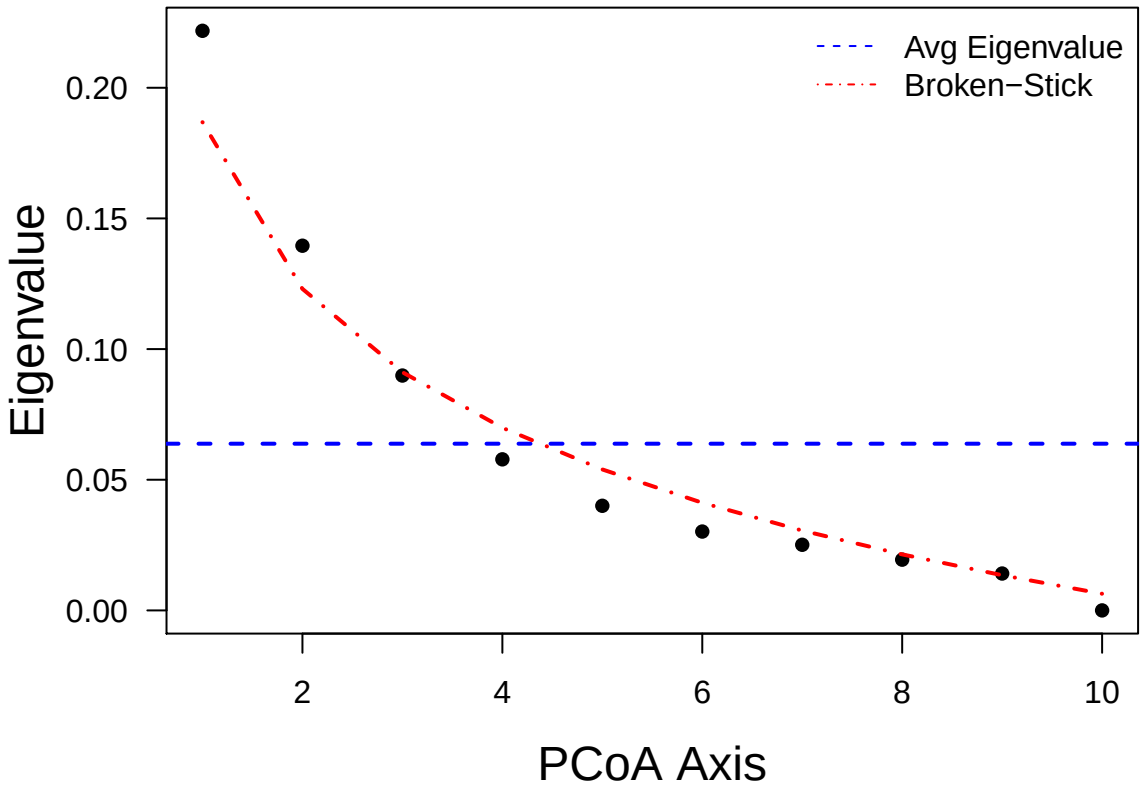
```r
plot((rowSums(active.NPA)/rowSums(totalPA))[seq(2, 20, by = 2)] ~ res.div$res.simpsE,
     xlab = "Resource Evennes", ylab = "Proportion of Active Taxa")
res.ev <- lm((rowSums(active.NPA)/rowSums(totalPA))[seq(2, 20, by = 2)] ~ res.div$res.simpsE)
abline(res.ev)
```



Between site comparisions of resources

```r
# Calculate Bray-Curtis
res.db <- vegdist(resREL, method = "bray")
```

```
res.pcoa <- cmdscale(res.db, eig = TRUE, k = 3)
explainvar1 <- round(res.pcoa$eig[1] / sum(res.pcoa$eig), 3) * 100
explainvar2 <- round(res.pcoa$eig[2] / sum(res.pcoa$eig), 3) * 100
explainvar3 <- round(res.pcoa$eig[3] / sum(res.pcoa$eig), 3) * 100
sum.eig <- sum(explainvar1, explainvar2, explainvar3)

# Define Plot Parameters
par(mar = c(5, 5, 1, 2) + 0.1)

# Plot Eigenvalues
plot(res.pcoa$eig, xlab = "PCoA Axis", ylab = "Eigenvalue",
     las = 1, cex.lab = 1.5, pch = 16)

# Add Expectation based on Kaiser-Guttman criterion and Broken Stick Model
abline(h = mean(res.pcoa$eig), lty = 2, lwd = 2, col = "blue")
b.stick <- bstick(10, sum(res.pcoa$eig))
lines(1:10, b.stick, type = "l", lty = 4, lwd = 2, col = "red")

# Add Legend
legend("topright", legend = c("Avg Eigenvalue", "Broken-Stick"),
       lty = c(2, 4), bty = "n", col = c("blue", "red"))
```



Figre 6: Resource Differences Across Sites

```
png(filename="../figures/Figure6.png",
    width = 1200, height = 1200, res = 96*2)
```

```
# Define Plot Parameters
par(mar = c(5, 5, 1, 1) + 0.1)

# Initiate Plot
plot(res.pcoa$points[ ,1], res.pcoa$points[ ,2], ylim = c(-0.25, 0.3),
     xlim = c(-0.4, 0.4),
     xlab = paste("PCoA 1 (", explainvar1, "%)", sep = ""),
     ylab = paste("PCoA 2 (", explainvar2, "%)", sep = ""),
     pch = 16, cex = 2.0, type = "n", cex.lab = 1.5, cex.axis = 1.2, axes = FALSE)

# Add Axes
axis(side = 1, labels = T, lwd.ticks = 2, cex.axis = 1.2, las = 1)
axis(side = 2, labels = T, lwd.ticks = 2, cex.axis = 1.2, las = 1)
abline(h = 0, v = 0, lty = 3)
box(lwd = 2)

# Add Points & Labels
points(res.pcoa$points[ ,1], res.pcoa$points[ ,2],
       pch = 19, cex = 3, bg = "gray", col = "gray")
text(res.pcoa$points[ ,1], res.pcoa$points[ ,2],
     labels = row.names(res.pcoa$points))
dev.off() # this writes plot to folder
graphics.off() # shuts doum open devices
par(opar)
```

Resource Explainations of Differences

```
OTUsREL2012.DNA <- OTUsREL[which(design$Year == "2012" & design$Molecule == "DNA"), ]
OTUsREL2012.DNA <- OTUsREL2012.DNA[ , colSums(OTUsREL2012.DNA > 0)]
OTUsREL2012.RNA <- OTUsREL[which(design$Year == "2012" & design$Molecule == "DNA"), ]
OTUsREL2012.RNA <- OTUsREL2012.RNA[ , colSums(OTUsREL2012.RNA > 0)]
active.N2012 <- active.N[grep("2012", rownames(active.N)), ]
rownames(OTUsREL2012.DNA) <- design$Lake[which(design$Year == "2012" & design$Molecule == "DNA")]
rownames(OTUsREL2012.RNA) <- design$Lake[which(design$Year == "2012" & design$Molecule == "DNA")]
rownames(active.N2012) <- design$Lake[which(design$Year == "2012" & design$Molecule == "DNA")]

# DNA
dbrda2012 <- capscale(OTUsREL2012.DNA ~ nuts2012$DOC + nuts2012$TN + nuts2012$TP, add =T, distance = "br
anova(dbrda2012)
```

```
## Permutation test for capscale under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: capscale(formula = OTUsREL2012.DNA ~ nuts2012$DOC + nuts2012$TN + nuts2012$TP, distance = "bra
##          Df SumOfSqs      F Pr(>F)
## Model     3  0.16971 1.9941  0.215
## Residual  6  0.17021
```

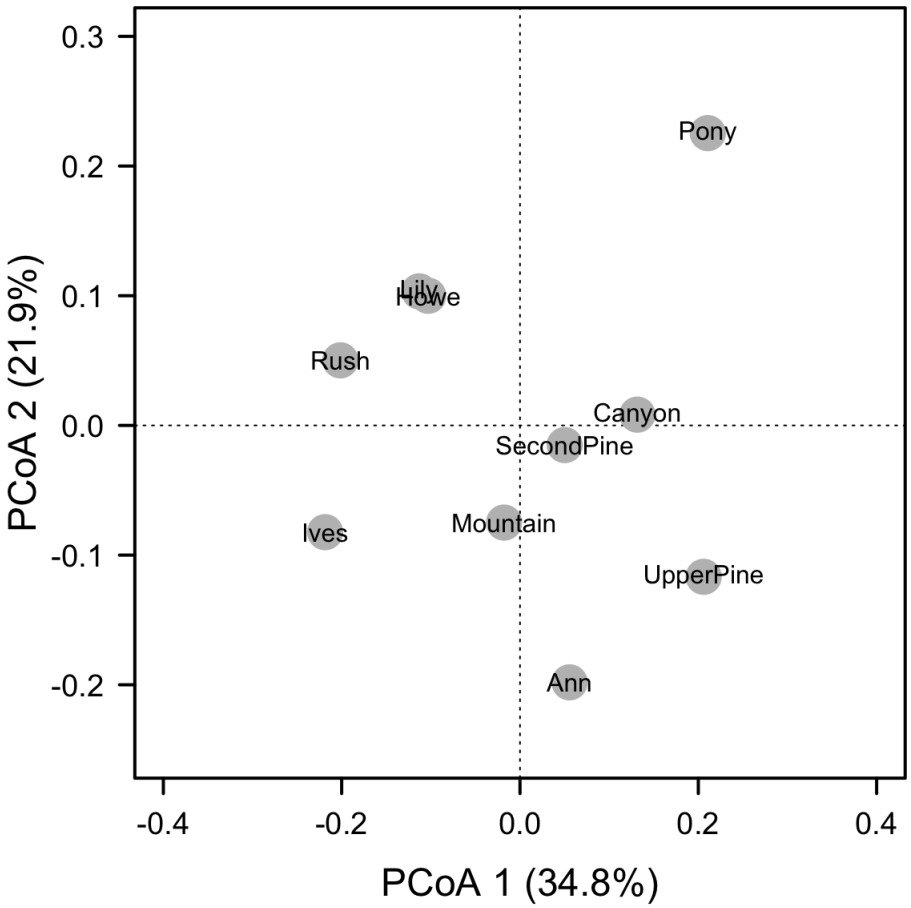


Figure 7: Resource Ordination

```
RsquareAdj(dbrda2012)
```

```
## $r.squared
## [1] 0.4992619
##
## $adj.r.squared
## [1] 0.2488928
```

```
coef(dbrda2012)
```

```
##                       CAP1        CAP2       CAP3
## nuts2012$DOC   0.13342556  0.02901989  0.0498605
## nuts2012$TN  -11.82590207  3.55032202 13.0769149
## nuts2012$TP   -0.03009888 -0.00379306 -0.0765502
```

```
# RNA
dbrda2012 <- capscale(OTUsREL2012.RNA ~ nuts2012$DOC + nuts2012$TN + nuts2012$TP, add =T, distance = "br
anova(dbrda2012)
```

```
## Permutation test for capscale under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: capscale(formula = OTUsREL2012.RNA ~ nuts2012$DOC + nuts2012$TN + nuts2012$TP, distance = "bra
##          Df SumOfSqs      F Pr(>F)
## Model     3  0.16971 1.9941   0.22
## Residual  6  0.17021
```

```
RsquareAdj(dbrda2012)
```

```
## $r.squared
## [1] 0.4992619
##
## $adj.r.squared
## [1] 0.2488928
```

```
coef(dbrda2012)
```

```
##                       CAP1        CAP2       CAP3
## nuts2012$DOC   0.13342556  0.02901989  0.0498605
## nuts2012$TN  -11.82590207  3.55032202 13.0769149
## nuts2012$TP   -0.03009888 -0.00379306 -0.0765502
```

```
# Active
dbrda2012 <- capscale(active.N2012 ~ nuts2012$DOC + nuts2012$TN + nuts2012$TP, add =T, distance = "bray
anova(dbrda2012)
```

```
## Permutation test for capscale under reduced model
## Permutation: free
## Number of permutations: 999
```

```
##
## Model: capscale(formula = active.N2012 ~ nuts2012$DOC + nuts2012$TN + nuts2012$TP, distance = "bray"
##          Df SumOfSqs      F Pr(>F)
## Model     3  0.82748 2.4034  0.012 *
## Residual  6  0.68859
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
RsquareAdj(dbrda2012)
```

```
## $r.squared
## [1] 0.5458069
##
## $adj.r.squared
## [1] 0.3187103
```

```
coef(dbrda2012)
```

```
##                      CAP1        CAP2        CAP3
## nuts2012$DOC  0.10283460 -0.09299717  0.04367120
## nuts2012$TN  -6.62700932  8.32801029 14.49791160
## nuts2012$TP  -0.01332741  0.03660606 -0.07254405
```

```
# Resoruces
chem.dbrda <- capscale(resREL ~ nuts2012$DOC + nuts2012$TN + nuts2012$TP, add =T, distance = "bray")
anova(chem.dbrda)
```

```
## Permutation test for capscale under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: capscale(formula = resREL ~ nuts2012$DOC + nuts2012$TN + nuts2012$TP, distance = "bray", add =
##          Df SumOfSqs      F Pr(>F)
## Model     3  0.22152 1.0641  0.428
## Residual  6  0.41634
```

```
RsquareAdj(chem.dbrda)
```

```
## $r.squared
## [1] 0.3472839
##
## $adj.r.squared
## [1] 0.02092581
```

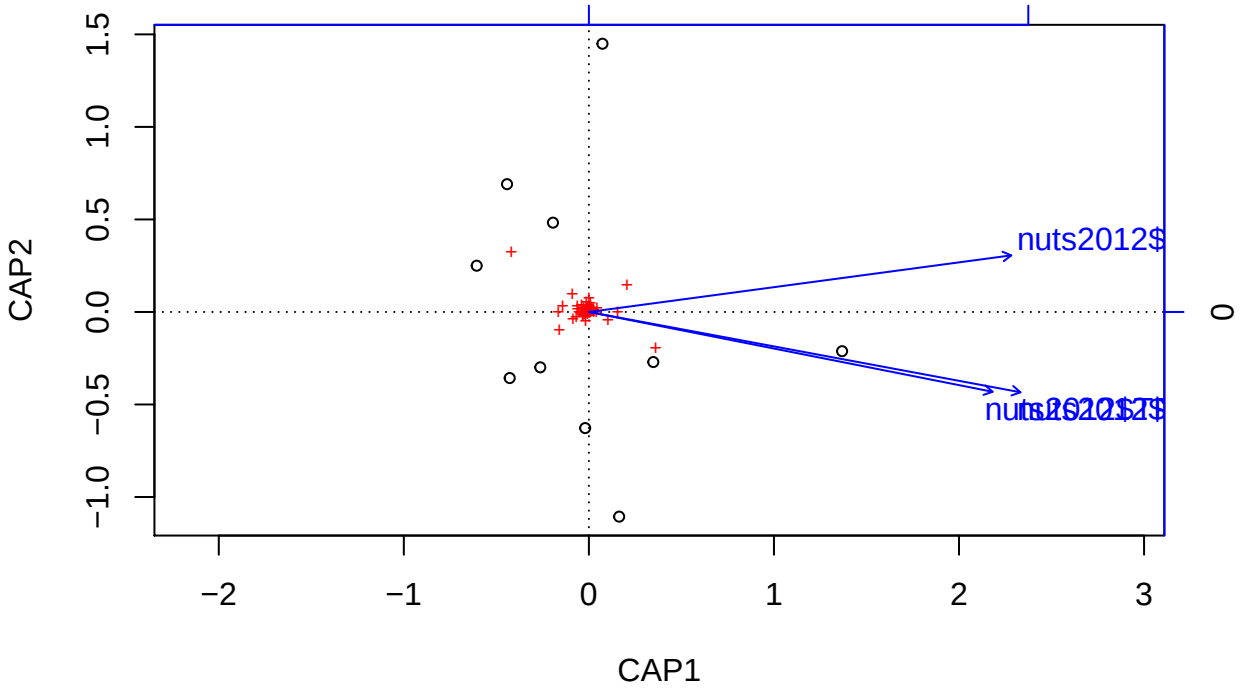
```
coef(chem.dbrda)
```

```
##                      CAP1        CAP2          CAP3
## nuts2012$DOC  0.026743857  0.14282901   0.003904343
## nuts2012$TN   4.923722250 -6.24185828 -16.132532747
## nuts2012$TP  -0.007734582 -0.05580434   0.060052598
```

```
anova.cca(chem.dbrda, step=1000)
```

```
## Permutation test for capscale under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: capscale(formula = resREL ~ nuts2012$DOC + nuts2012$TN + nuts2012$TP, distance = "bray", add =
##          Df SumOfSqs      F Pr(>F)
## Model     3  0.22152 1.0641  0.398
## Residual  6  0.41634
```

```
plot(chem.dbrda)
```




```
lmod <- as.mlm(chem.dbrda)
lmod
```

```
##
## Call:
## lm(formula = x$CCA$wa ~ . - 1, data = as.data.frame(X))
##
## Coefficients:
##                  CAP1        CAP2        CAP3
## `nuts2012$DOC`    0.026744    0.142829    0.003904
## `nuts2012$TN`     4.923722   -6.241858  -16.132533
## `nuts2012$TP`    -0.007735   -0.055804    0.060053
```

```
summary(lmod)
```

```
## Response CAP1 :
```

```
##
## Call:
## lm(formula = CAP1 ~ (`nuts2012$DOC` + `nuts2012$TN` + `nuts2012$TP`) -
##     1, data = as.data.frame(X))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.25188 -0.09381 -0.01930  0.11048  0.23650
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## `nuts2012$DOC`  0.026744   0.024653   1.085    0.314
## `nuts2012$TN`   4.923722   3.050169   1.614    0.151
## `nuts2012$TP`  -0.007735   0.013965  -0.554    0.597
##
## Residual standard error: 0.1696 on 7 degrees of freedom
## Multiple R-squared:  0.8324, Adjusted R-squared:  0.7606
## F-statistic: 11.59 on 3 and 7 DF,  p-value: 0.004183
##
##
## Response CAP2 :
##
## Call:
## lm(formula = CAP2 ~ (`nuts2012$DOC` + `nuts2012$TN` + `nuts2012$TP`) -
##     1, data = as.data.frame(X))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.64586 -0.11451  0.02253  0.14373  0.62010
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## `nuts2012$DOC`  0.14283    0.05532   2.582   0.0364 *
## `nuts2012$TN`  -6.24186    6.84479  -0.912   0.3921
## `nuts2012$TP`  -0.05580    0.03134  -1.781   0.1182
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3806 on 7 degrees of freedom
## Multiple R-squared:  0.4965, Adjusted R-squared:  0.2808
## F-statistic: 2.301 on 3 and 7 DF,  p-value: 0.164
##
##
## Response CAP3 :
##
## Call:
## lm(formula = CAP3 ~ (`nuts2012$DOC` + `nuts2012$TN` + `nuts2012$TP`) -
##     1, data = as.data.frame(X))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.23671 -0.09146  0.00380  0.03683  0.31379
##
## Coefficients:
```

```
##                   Estimate Std. Error t value Pr(>|t|)
## `nuts2012$DOC`    0.003904   0.028820   0.135  0.89605
## `nuts2012$TN`   -16.132533   3.565688  -4.524  0.00272 **
## `nuts2012$TP`     0.060053   0.016325   3.679  0.00787 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1983 on 7 degrees of freedom
## Multiple R-squared:  0.7842, Adjusted R-squared:  0.6917
## F-statistic:  8.48 on 3 and 7 DF,  p-value: 0.009909
```

```
chem.dbrda <- capscale(resREL ~ log(nuts2012$DOC), add =T, distance = "bray")
anova(chem.dbrda)
```

```
## Permutation test for capscale under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: capscale(formula = resREL ~ log(nuts2012$DOC), distance = "bray", add = T)
##          Df SumOfSqs      F Pr(>F)
## Model     1  0.12420 1.9343  0.037 *
## Residual  8  0.51366
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
RsquareAdj(chem.dbrda)
```

```
## $r.squared
## [1] 0.1947118
##
## $adj.r.squared
## [1] 0.09405081
```

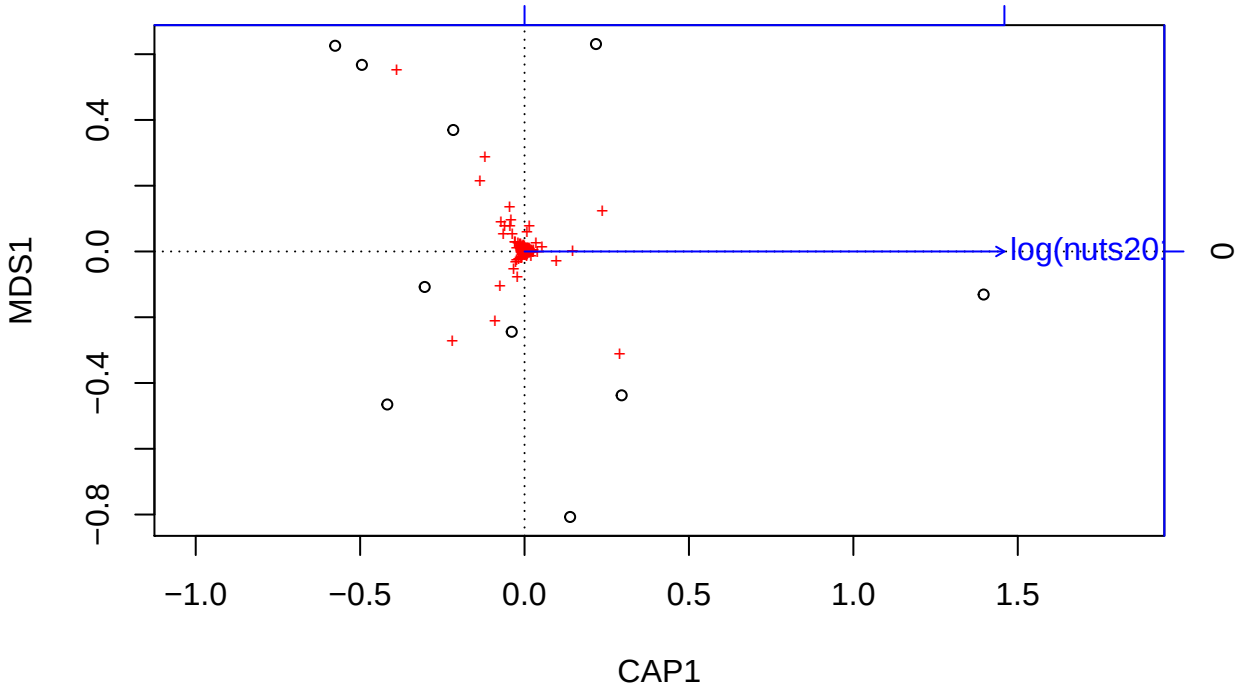
```
coef(chem.dbrda)
```

```
##                         CAP1
## log(nuts2012$DOC) 0.6004698
```

```
anova.cca(chem.dbrda, step=1000)
```

```
## Permutation test for capscale under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: capscale(formula = resREL ~ log(nuts2012$DOC), distance = "bray", add = T)
##          Df SumOfSqs      F Pr(>F)
## Model     1  0.12420 1.9343  0.043 *
## Residual  8  0.51366
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
plot(chem.dbrda)
```




```
lmod <- as.mlm(chem.dbrda)
lmod
```

```
##
## Call:
## lm(formula = x$CCA$wa ~ . - 1, data = as.data.frame(X))
##
## Coefficients:
## `log(nuts2012$DOC)`
##              0.6005
```

```
summary(lmod)
```

```
##
## Call:
## lm(formula = x$CCA$wa ~ . - 1, data = as.data.frame(X))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.29143 -0.09346  0.05226  0.10989  0.24425
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## `log(nuts2012$DOC)`   0.6005     0.1000   6.004 0.000201 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1666 on 9 degrees of freedom
```

```
## Multiple R-squared:  0.8002, Adjusted R-squared:  0.778
## F-statistic: 36.05 on 1 and 9 DF,  p-value: 0.0002015
```

```
require(cocorresp)
```

```
## Loading required package: cocorresp
```

```
#test1 <- coca(OTUsREL2012.RNA, resREL, n.axes = 4)

# Variance Partitioning

nuts3 <- cbind(scale(log(nuts2012$DOC)), scale(log1p(nuts2012$TP)))
# nuts3 <- scale(log(nuts2012$DOC))
rownames(nuts3) <- nuts2012$sample

res.db <- vegdist(resREL, method = "altGower")
res.pcoa <- cmdscale(res.db, eig = TRUE, k = 5)

OTUsREL.log2012 <- OTUsREL.log[design$Year == "2012" & design$Molecule == "RNA", ]
OTUsREL2012 <- OTUsREL[design$Year == "2012" & design$Molecule == "RNA", ]
spe.pcoa <- cmdscale(vegdist(OTUsREL2012, method="bray"), eig = TRUE, k = 5)


# Active
HMWFvarpart <- varpart(spe.pcoa$points[, 1:2], nuts3, res.pcoa$points[, 1:2])
HMWFvarpart <- varpart(OTUsREL.log2012, nuts3, res.pcoa$points)
HMWFvarpart
```

```
##
## Partition of variation in RDA
##
## Call: varpart(Y = OTUsREL.log2012, X = nuts3, res.pcoa$points)
##
## Explanatory tables:
## X1:  nuts3
## X2:  res.pcoa$points
##
## No. of explanatory tables: 2
## Total variation (SS): 118316
##              Variance: 13146
## No. of observations: 10
##
## Partition table:
##                       Df R.squared Adj.R.squared Testable
## [a+b] = X1             2   0.43297       0.27097     TRUE
## [b+c] = X2             5   0.69001       0.30253     TRUE
## [a+b+c] = X1+X2        7   0.84873       0.31929     TRUE
## Individual fractions
## [a] = X1|X2            2                 0.01676     TRUE
## [b]                    0                 0.25421    FALSE
## [c] = X2|X1            5                 0.04832     TRUE
## [d] = Residuals                          0.68071    FALSE
## ---
## Use function 'rda' to test significance of fractions of interest
```

```
png(filename="../figures/Figure7.png",
    width = 1200, height = 1200, res = 96*2)

plot(HMWFvarpart)

dev.off() # this writes plot to folder
```

```
## pdf
##   2
```

```
graphics.off() # shuts down open devices
par(opar)

anova.cca(rda(spe.pcoa$points, nuts3), step=1000) #[a+b]
```

```
## Permutation test for rda under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: rda(X = spe.pcoa$points, Y = nuts3)
##          Df Variance      F Pr(>F)
## Model     2 0.073531 2.8079  0.009 **
## Residual  7 0.091656
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova.cca(rda(spe.pcoa$points, res.pcoa$points), step=1000) #[b+c]
```

```
## Permutation test for rda under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: rda(X = spe.pcoa$points, Y = res.pcoa$points)
##          Df Variance      F Pr(>F)
## Model     5  0.11262 1.7138  0.092 .
## Residual  4  0.05257
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova.cca(rda(spe.pcoa$points, cbind(nuts3, res.pcoa$points)), step=1000) #[a+b+c]
```

```
## Permutation test for rda under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: rda(X = spe.pcoa$points, Y = cbind(nuts3, res.pcoa$points))
##          Df Variance      F Pr(>F)
## Model     7 0.134883 1.2717  0.345
## Residual  2 0.030304
```

```r
anova.cca(rda(spe.pcoa$points, res.pcoa$points, nuts3), step=1000) # [a]
```

```
## Permutation test for rda under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: rda(X = spe.pcoa$points, Y = res.pcoa$points, Z = nuts3)
##          Df Variance      F Pr(>F)
## Model     5 0.061352 0.8098  0.696
## Residual  2 0.030304
```

```r
anova.cca(rda(spe.pcoa$points, nuts3, res.pcoa$points), step=1000) # [c]
```

```
## Permutation test for rda under reduced model
## Permutation: free
## Number of permutations: 999
##
## Model: rda(X = spe.pcoa$points, Y = nuts3, Z = res.pcoa$points)
##          Df Variance      F Pr(>F)
## Model     2 0.022267 0.7348  0.651
## Residual  2 0.030304
```

Phylogenetic Approach

Resource distirubiton is not able to explain the distribution of all organisms combined. But why should we expect this assumption?

Remove Cyanobacteria

Microbial Functional Groups

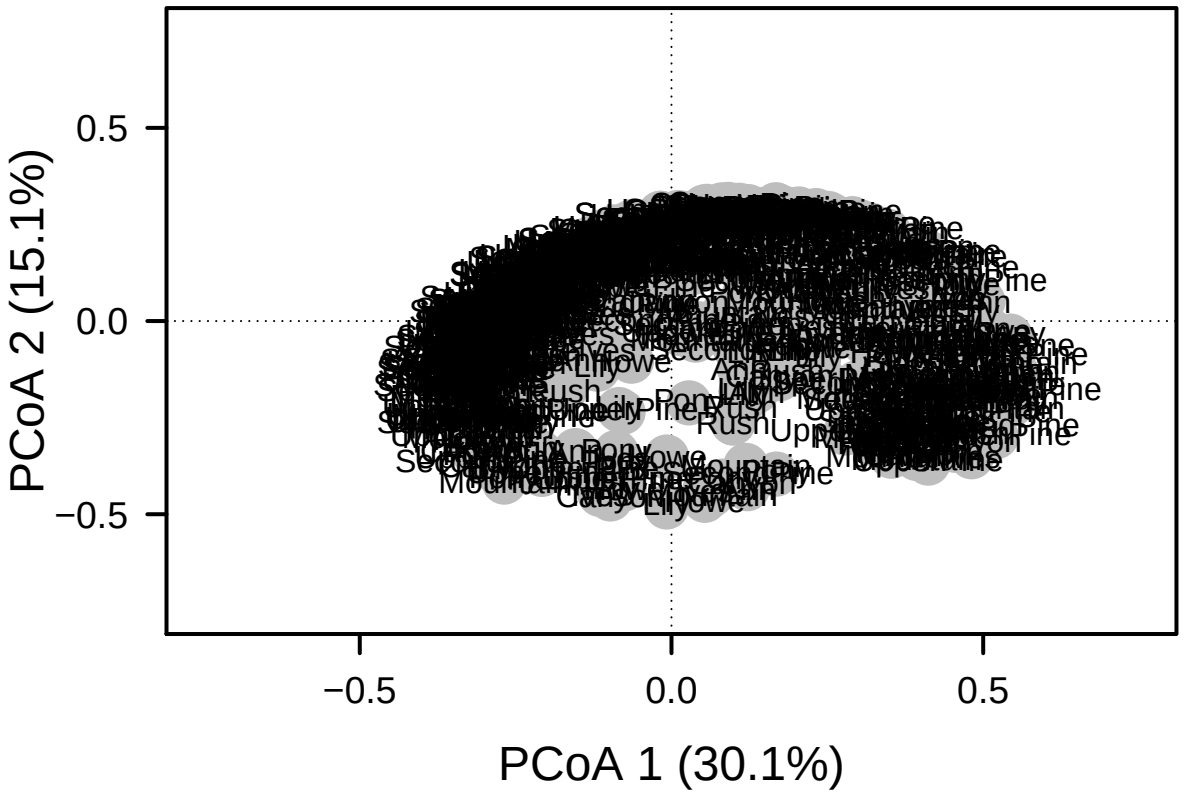
Define RDP microbial groups Test each along with resource differences Who are the generalist taxa (which are active everywhere) Are generalists more abundant when resource concentration is higher?

Can we group resources

What are the similar groups of resources: cluster resources based on abundance Can we cluster based on chemical data?

```r
res.dist <- vegdist(t(resREL), "bray")

res2.pcoa <- cmdscale(res.dist, eig = TRUE, k = 3)
explainvar1 <- round(res2.pcoa$eig[1] / sum(res2.pcoa$eig), 3) * 100
explainvar2 <- round(res2.pcoa$eig[2] / sum(res2.pcoa$eig), 3) * 100
explainvar3 <- round(res2.pcoa$eig[3] / sum(res2.pcoa$eig), 3) * 100
sum.eig <- sum(explainvar1, explainvar2, explainvar3)
```

```r
# Define Plot Parameters
par(mar = c(5, 5, 1, 1) + 0.1)

# Initiate Plot
plot(res2.pcoa$points[ ,1], res2.pcoa$points[ ,2], ylim = c(-0.75, 0.75),
     xlim = c(-0.75, 0.75),
     xlab = paste("PCoA 1 (", explainvar1, "%)", sep = ""),
     ylab = paste("PCoA 2 (", explainvar2, "%)", sep = ""),
     pch = 16, cex = 2.0, type = "n", cex.lab = 1.5, cex.axis = 1.2, axes = FALSE)

# Add Axes
axis(side = 1, labels = T, lwd.ticks = 2, cex.axis = 1.2, las = 1)
axis(side = 2, labels = T, lwd.ticks = 2, cex.axis = 1.2, las = 1)
abline(h = 0, v = 0, lty = 3)
box(lwd = 2)

# Add Points & Labels
points(res2.pcoa$points[ ,1], res2.pcoa$points[ ,2],
       pch = 19, cex = 3, bg = "gray", col = "gray")
text(res2.pcoa$points[ ,1], res2.pcoa$points[ ,2],
     labels = row.names(res.pcoa$points))
```




```r
# Distances between molecules given sites
summary(resREL) # the data
```

```
##        C1                  C2                C3
##  Min.   :0.0000000   Min.   :0.00000   Min.   :0.001349
```

```
##  1st Qu.:0.0006769   1st Qu.:0.01021   1st Qu.:0.001874
##  Median :0.0021680   Median :0.02382   Median :0.002522
##  Mean   :0.0017680   Mean   :0.03596   Mean   :0.002322
##  3rd Qu.:0.0025300   3rd Qu.:0.06352   3rd Qu.:0.002664
##  Max.   :0.0034959   Max.   :0.09267   Max.   :0.003047
##        C4                  C6                  C8
##  Min.   :0.0000000   Min.   :0.000000   Min.   :0.0000000
##  1st Qu.:0.0006889   1st Qu.:0.008753   1st Qu.:0.0004477
##  Median :0.0019029   Median :0.011175   Median :0.0014253
##  Mean   :0.0023593   Mean   :0.015287   Mean   :0.0016791
##  3rd Qu.:0.0034990   3rd Qu.:0.021488   3rd Qu.:0.0027515
##  Max.   :0.0062077   Max.   :0.034030   Max.   :0.0036636
##        C9                  C10                 C12
##  Min.   :0.0000000   Min.   :0.001596   Min.   :0.00000
##  1st Qu.:0.0008124   1st Qu.:0.001784   1st Qu.:0.00000
##  Median :0.0020051   Median :0.002065   Median :0.00000
##  Mean   :0.0025981   Mean   :0.002571   Mean   :0.01207
##  3rd Qu.:0.0041760   3rd Qu.:0.002461   3rd Qu.:0.01055
##  Max.   :0.0065816   Max.   :0.006766   Max.   :0.07706
##       C15                 C16                 C17
##  Min.   :0.0007315   Min.   :0.001196   Min.   :0.0006099
##  1st Qu.:0.0009698   1st Qu.:0.001904   1st Qu.:0.0014167
##  Median :0.0012655   Median :0.002072   Median :0.0017960
##  Mean   :0.0013874   Mean   :0.002297   Mean   :0.0017094
##  3rd Qu.:0.0016481   3rd Qu.:0.002393   3rd Qu.:0.0019740
##  Max.   :0.0025889   Max.   :0.004384   Max.   :0.0024360
##       C18                 C21                 C22
##  Min.   :0.0007549   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0008615   1st Qu.:0.0000000   1st Qu.:0.0001666
##  Median :0.0009738   Median :0.0000000   Median :0.0003782
##  Mean   :0.0012026   Mean   :0.0007879   Mean   :0.0004249
##  3rd Qu.:0.0013444   3rd Qu.:0.0007414   3rd Qu.:0.0005896
##  Max.   :0.0025072   Max.   :0.0033198   Max.   :0.0010642
##       C23                 C24                 C25
##  Min.   :0.0005187   Min.   :0.0008872   Min.   :0.0005300
##  1st Qu.:0.0006114   1st Qu.:0.0012307   1st Qu.:0.0009237
##  Median :0.0007896   Median :0.0012514   Median :0.0014235
##  Mean   :0.0009253   Mean   :0.0014909   Mean   :0.0013972
##  3rd Qu.:0.0010573   3rd Qu.:0.0015984   3rd Qu.:0.0017669
##  Max.   :0.0017919   Max.   :0.0030045   Max.   :0.0021955
##       C26                 C27                 C30
##  Min.   :0.0007041   Min.   :0.0005791   Min.   :0.000000
##  1st Qu.:0.0008437   1st Qu.:0.0007552   1st Qu.:0.000000
##  Median :0.0010062   Median :0.0010735   Median :0.002619
##  Mean   :0.0011499   Mean   :0.0012338   Mean   :0.002481
##  3rd Qu.:0.0014643   3rd Qu.:0.0016358   3rd Qu.:0.003420
##  Max.   :0.0019654   Max.   :0.0023398   Max.   :0.009302
##       C34                 C35                 C36
##  Min.   :0.000e+00   Min.   :0.0004700   Min.   :0.001923
##  1st Qu.:0.000e+00   1st Qu.:0.0007526   1st Qu.:0.002162
##  Median :0.000e+00   Median :0.0009726   Median :0.002765
##  Mean   :9.269e-05   Mean   :0.0009933   Mean   :0.002983
##  3rd Qu.:1.068e-04   3rd Qu.:0.0011147   3rd Qu.:0.003508
##  Max.   :4.312e-04   Max.   :0.0019407   Max.   :0.004929
```

```
##       C37                C39                C40
##  Min.   :0.0008008   Min.   :0.0006464   Min.   :0.000872
##  1st Qu.:0.0013065   1st Qu.:0.0011249   1st Qu.:0.001251
##  Median :0.0015571   Median :0.0013664   Median :0.001323
##  Mean   :0.0016492   Mean   :0.0014357   Mean   :0.001772
##  3rd Qu.:0.0019003   3rd Qu.:0.0016469   3rd Qu.:0.002170
##  Max.   :0.0030991   Max.   :0.0027018   Max.   :0.003942
##       C41                C43                C45
##  Min.   :0.0005675   Min.   :0.000e+00   Min.   :0.0002968
##  1st Qu.:0.0006183   1st Qu.:8.346e-05   1st Qu.:0.0003817
##  Median :0.0007413   Median :2.716e-04   Median :0.0004246
##  Mean   :0.0008867   Mean   :5.360e-04   Mean   :0.0004563
##  3rd Qu.:0.0008489   3rd Qu.:8.657e-04   3rd Qu.:0.0005194
##  Max.   :0.0023745   Max.   :1.885e-03   Max.   :0.0007426
##       C48                C51                C52
##  Min.   :0.000e+00   Min.   :0.0009345   Min.   :0.001120
##  1st Qu.:0.000e+00   1st Qu.:0.0019101   1st Qu.:0.001460
##  Median :0.000e+00   Median :0.0029662   Median :0.001662
##  Mean   :9.741e-05   Mean   :0.0031205   Mean   :0.002010
##  3rd Qu.:0.000e+00   3rd Qu.:0.0039750   3rd Qu.:0.002701
##  Max.   :6.006e-04   Max.   :0.0064976   Max.   :0.003164
##       C53                C54                C55
##  Min.   :0.0002193   Min.   :0.001273   Min.   :0.0004134
##  1st Qu.:0.0006245   1st Qu.:0.002034   1st Qu.:0.0009660
##  Median :0.0010364   Median :0.002218   Median :0.0010965
##  Mean   :0.0012340   Mean   :0.002231   Mean   :0.0013457
##  3rd Qu.:0.0016400   3rd Qu.:0.002580   3rd Qu.:0.0015344
##  Max.   :0.0032822   Max.   :0.002973   Max.   :0.0030224
##       C56                C57                C58
##  Min.   :0.001189   Min.   :0.0009858   Min.   :0.001117
##  1st Qu.:0.001639   1st Qu.:0.0014930   1st Qu.:0.001461
##  Median :0.001902   Median :0.0016593   Median :0.002148
##  Mean   :0.002050   Mean   :0.0018152   Mean   :0.002110
##  3rd Qu.:0.002107   3rd Qu.:0.0018626   3rd Qu.:0.002477
##  Max.   :0.004055   Max.   :0.0030216   Max.   :0.003729
##       C59                C63                C64
##  Min.   :0.001688   Min.   :0.0009083   Min.   :0.0001369
##  1st Qu.:0.002780   1st Qu.:0.0013450   1st Qu.:0.0007349
##  Median :0.002963   Median :0.0016361   Median :0.0010733
##  Mean   :0.003140   Mean   :0.0015248   Mean   :0.0010186
##  3rd Qu.:0.003632   3rd Qu.:0.0017835   3rd Qu.:0.0013766
##  Max.   :0.004464   Max.   :0.0019122   Max.   :0.0017041
##       C65                C66                C67
##  Min.   :0.0006838   Min.   :0.001441   Min.   :0.0009683
##  1st Qu.:0.0010515   1st Qu.:0.001682   1st Qu.:0.0010593
##  Median :0.0011644   Median :0.001926   Median :0.0012783
##  Mean   :0.0013102   Mean   :0.002085   Mean   :0.0015913
##  3rd Qu.:0.0013685   3rd Qu.:0.002161   3rd Qu.:0.0017875
##  Max.   :0.0028256   Max.   :0.004083   Max.   :0.0039310
##       C68                C69                C72
##  Min.   :0.0000000   Min.   :0.0007864   Min.   :0.0000000
##  1st Qu.:0.0001247   1st Qu.:0.0010588   1st Qu.:0.0000000
##  Median :0.0002230   Median :0.0011316   Median :0.0000000
##  Mean   :0.0003940   Mean   :0.0013036   Mean   :0.0002051
```

```
##  3rd Qu.:0.0003821   3rd Qu.:0.0013292   3rd Qu.:0.0000000
##  Max.   :0.0016939   Max.   :0.0028517   Max.   :0.0019273
##       C74                 C76                 C78
##  Min.   :0.0006201   Min.   :0.0000671   Min.   :0.000e+00
##  1st Qu.:0.0008305   1st Qu.:0.0003063   1st Qu.:0.000e+00
##  Median :0.0009772   Median :0.0004837   Median :0.000e+00
##  Mean   :0.0010205   Mean   :0.0007027   Mean   :2.654e-05
##  3rd Qu.:0.0011286   3rd Qu.:0.0008449   3rd Qu.:0.000e+00
##  Max.   :0.0017580   Max.   :0.0026257   Max.   :2.654e-04
##       C81                 C82                 C86
##  Min.   :0.0003159   Min.   :0.0000000   Min.   :0.000000
##  1st Qu.:0.0006907   1st Qu.:0.0002574   1st Qu.:0.002807
##  Median :0.0008923   Median :0.0037626   Median :0.007846
##  Mean   :0.0010575   Mean   :0.0066804   Mean   :0.008590
##  3rd Qu.:0.0014611   3rd Qu.:0.0082167   3rd Qu.:0.013323
##  Max.   :0.0022194   Max.   :0.0221693   Max.   :0.019905
##       C87                 C88                 C89
##  Min.   :0.0000000   Min.   :7.543e-05   Min.   :0.001114
##  1st Qu.:0.0000000   1st Qu.:5.540e-04   1st Qu.:0.001465
##  Median :0.0000000   Median :1.085e-03   Median :0.001947
##  Mean   :0.0001133   Mean   :1.049e-03   Mean   :0.001992
##  3rd Qu.:0.0000000   3rd Qu.:1.478e-03   3rd Qu.:0.002376
##  Max.   :0.0010061   Max.   :2.014e-03   Max.   :0.003237
##       C90                 C91                 C92
##  Min.   :0.0002552   Min.   :0.0003913   Min.   :0.001532
##  1st Qu.:0.0005255   1st Qu.:0.0008213   1st Qu.:0.001796
##  Median :0.0006114   Median :0.0011167   Median :0.002070
##  Mean   :0.0006082   Mean   :0.0011378   Mean   :0.002101
##  3rd Qu.:0.0006947   3rd Qu.:0.0013243   3rd Qu.:0.002435
##  Max.   :0.0009990   Max.   :0.0019275   Max.   :0.002763
##       C93                 C94                C95
##  Min.   :0.0004021   Min.   :0.001079   Min.   :0.0002646
##  1st Qu.:0.0009305   1st Qu.:0.001738   1st Qu.:0.0011197
##  Median :0.0010819   Median :0.002168   Median :0.0014824
##  Mean   :0.0012279   Mean   :0.002373   Mean   :0.0014754
##  3rd Qu.:0.0014568   3rd Qu.:0.002849   3rd Qu.:0.0020812
##  Max.   :0.0023505   Max.   :0.003942   Max.   :0.0022901
##       C96                 C97                C99
##  Min.   :0.0004647   Min.   :0.001048   Min.   :0.001967
##  1st Qu.:0.0007220   1st Qu.:0.001180   1st Qu.:0.002442
##  Median :0.0009420   Median :0.001368   Median :0.002760
##  Mean   :0.0010435   Mean   :0.001407   Mean   :0.002681
##  3rd Qu.:0.0012413   3rd Qu.:0.001603   3rd Qu.:0.002925
##  Max.   :0.0021508   Max.   :0.001911   Max.   :0.003301
##       C101               C102               C103
##  Min.   :0.001010   Min.   :0.001707   Min.   :0.0006557
##  1st Qu.:0.001156   1st Qu.:0.002036   1st Qu.:0.0011064
##  Median :0.001472   Median :0.002538   Median :0.0014048
##  Mean   :0.001775   Mean   :0.002653   Mean   :0.0014927
##  3rd Qu.:0.002029   3rd Qu.:0.003056   3rd Qu.:0.0017457
##  Max.   :0.004384   Max.   :0.004592   Max.   :0.0028412
##       C104                C105                C106
##  Min.   :0.0001818   Min.   :0.0000000   Min.   :0.000000
##  1st Qu.:0.0007646   1st Qu.:0.0002549   1st Qu.:0.000529
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##  Median :0.0016225   Median :0.0004128   Median :0.001062
##  Mean   :0.0016078   Mean   :0.0004856   Mean   :0.001115
##  3rd Qu.:0.0022646   3rd Qu.:0.0008025   3rd Qu.:0.001620
##  Max.   :0.0033858   Max.   :0.0009414   Max.   :0.002454
##       C107                C108                C111
##  Min.   :0.0004344   Min.   :0.0001302   Min.   :0.001401
##  1st Qu.:0.0006998   1st Qu.:0.0006446   1st Qu.:0.002096
##  Median :0.0009511   Median :0.0007066   Median :0.002404
##  Mean   :0.0013134   Mean   :0.0007464   Mean   :0.002316
##  3rd Qu.:0.0018916   3rd Qu.:0.0009138   3rd Qu.:0.002738
##  Max.   :0.0031489   Max.   :0.0012402   Max.   :0.003026
##       C112                C115                C117
##  Min.   :0.0009737   Min.   :0.000e+00   Min.   :0.0005762
##  1st Qu.:0.0011885   1st Qu.:0.000e+00   1st Qu.:0.0008774
##  Median :0.0015258   Median :5.584e-05   Median :0.0011996
##  Mean   :0.0015552   Mean   :2.192e-04   Mean   :0.0012523
##  3rd Qu.:0.0017009   3rd Qu.:4.100e-04   3rd Qu.:0.0015011
##  Max.   :0.0027301   Max.   :7.136e-04   Max.   :0.0022778
##       C118                C120                C127
##  Min.   :0.0004198   Min.   :0.000000   Min.   :0.0000000
##  1st Qu.:0.0005646   1st Qu.:0.000000   1st Qu.:0.0000000
##  Median :0.0006073   Median :0.000000   Median :0.0000000
##  Mean   :0.0007512   Mean   :0.001352   Mean   :0.0001751
##  3rd Qu.:0.0008341   3rd Qu.:0.001003   3rd Qu.:0.0000000
##  Max.   :0.0016220   Max.   :0.008922   Max.   :0.0017509
##       C129                C130                C131
##  Min.   :0.0000000   Min.   :0.001054   Min.   :0.0004572
##  1st Qu.:0.0000000   1st Qu.:0.002862   1st Qu.:0.0012015
##  Median :0.0000000   Median :0.003327   Median :0.0016111
##  Mean   :0.0001768   Mean   :0.003884   Mean   :0.0016956
##  3rd Qu.:0.0000000   3rd Qu.:0.004095   3rd Qu.:0.0017781
##  Max.   :0.0017678   Max.   :0.010672   Max.   :0.0039623
##       C132               C133                C134
##  Min.   :0.001314   Min.   :0.0003817   Min.   :0.0005342
##  1st Qu.:0.001703   1st Qu.:0.0003991   1st Qu.:0.0007317
##  Median :0.002083   Median :0.0004367   Median :0.0014657
##  Mean   :0.002042   Mean   :0.0004748   Mean   :0.0012646
##  3rd Qu.:0.002371   3rd Qu.:0.0005229   3rd Qu.:0.0016090
##  Max.   :0.002763   Max.   :0.0006821   Max.   :0.0021862
##       C135                C136                C140
##  Min.   :0.0006133   Min.   :0.001381   Min.   :0.001878
##  1st Qu.:0.0008894   1st Qu.:0.002705   1st Qu.:0.002450
##  Median :0.0010229   Median :0.003202   Median :0.002929
##  Mean   :0.0009906   Mean   :0.003077   Mean   :0.002805
##  3rd Qu.:0.0011581   3rd Qu.:0.003617   3rd Qu.:0.003144
##  Max.   :0.0013017   Max.   :0.004160   Max.   :0.003848
##       C141                C142                C143
##  Min.   :0.0008382   Min.   :0.001034   Min.   :0.0004503
##  1st Qu.:0.0012592   1st Qu.:0.001283   1st Qu.:0.0008539
##  Median :0.0014575   Median :0.001683   Median :0.0014301
##  Mean   :0.0015294   Mean   :0.001895   Mean   :0.0014560
##  3rd Qu.:0.0019495   3rd Qu.:0.002538   3rd Qu.:0.0019110
##  Max.   :0.0022383   Max.   :0.003143   Max.   :0.0029519
##       C144               C145                C146
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##  Min.   :0.001450   Min.   :0.0002372   Min.   :0.0001942
##  1st Qu.:0.001631   1st Qu.:0.0005694   1st Qu.:0.0003917
##  Median :0.001946   Median :0.0007362   Median :0.0006803
##  Mean   :0.002302   Mean   :0.0007693   Mean   :0.0008982
##  3rd Qu.:0.002755   3rd Qu.:0.0009528   3rd Qu.:0.0011035
##  Max.   :0.004480   Max.   :0.0014154   Max.   :0.0029378
##       C147                C148                C151
##  Min.   :0.0006189   Min.   :0.0006330   Min.   :0.0002005
##  1st Qu.:0.0007153   1st Qu.:0.0007487   1st Qu.:0.0004396
##  Median :0.0008282   Median :0.0008858   Median :0.0007182
##  Mean   :0.0009235   Mean   :0.0010061   Mean   :0.0007716
##  3rd Qu.:0.0009001   3rd Qu.:0.0010577   3rd Qu.:0.0009615
##  Max.   :0.0018752   Max.   :0.0022391   Max.   :0.0018462
##       C153                C154                C156
##  Min.   :0.0002197   Min.   :0.0000000   Min.   :0.0004883
##  1st Qu.:0.0003277   1st Qu.:0.0005227   1st Qu.:0.0007088
##  Median :0.0004733   Median :0.0007816   Median :0.0011432
##  Mean   :0.0005972   Mean   :0.0007407   Mean   :0.0013475
##  3rd Qu.:0.0007011   3rd Qu.:0.0010587   3rd Qu.:0.0015200
##  Max.   :0.0015042   Max.   :0.0013663   Max.   :0.0033185
##       C157                C158                C160
##  Min.   :0.000e+00   Min.   :0.001143   Min.   :0.0008353
##  1st Qu.:0.000e+00   1st Qu.:0.001291   1st Qu.:0.0011903
##  Median :7.388e-05   Median :0.001484   Median :0.0012682
##  Mean   :2.688e-04   Mean   :0.001715   Mean   :0.0012965
##  3rd Qu.:3.149e-04   3rd Qu.:0.002125   3rd Qu.:0.0012926
##  Max.   :1.538e-03   Max.   :0.002640   Max.   :0.0018058
##       C163                C165                C168
##  Min.   :0.001172   Min.   :0.0000000   Min.   :0.0002310
##  1st Qu.:0.001333   1st Qu.:0.0000000   1st Qu.:0.0002445
##  Median :0.001443   Median :0.0000000   Median :0.0002701
##  Mean   :0.001595   Mean   :0.0003151   Mean   :0.0002820
##  3rd Qu.:0.001582   3rd Qu.:0.0004247   3rd Qu.:0.0003175
##  Max.   :0.002559   Max.   :0.0017895   Max.   :0.0003686
##       C169                C170                C171
##  Min.   :0.0000000   Min.   :0.000000   Min.   :0.01180
##  1st Qu.:0.0000000   1st Qu.:0.000000   1st Qu.:0.02433
##  Median :0.0000000   Median :0.002784   Median :0.04311
##  Mean   :0.0002668   Mean   :0.003643   Mean   :0.04346
##  3rd Qu.:0.0000000   3rd Qu.:0.006558   3rd Qu.:0.05796
##  Max.   :0.0013957   Max.   :0.011180   Max.   :0.08241
##       C172                C173                C183
##  Min.   :0.001136   Min.   :0.0000000   Min.   :0.000000
##  1st Qu.:0.003310   1st Qu.:0.0000000   1st Qu.:0.000749
##  Median :0.009710   Median :0.0001166   Median :0.001689
##  Mean   :0.010141   Mean   :0.0006674   Mean   :0.006471
##  3rd Qu.:0.016703   3rd Qu.:0.0007269   3rd Qu.:0.006971
##  Max.   :0.020794   Max.   :0.0043533   Max.   :0.029451
##       C187                C188                C191
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.000000
##  1st Qu.:2.428e-05   1st Qu.:9.449e-05   1st Qu.:0.000000
##  Median :4.870e-04   Median :2.168e-04   Median :0.000000
##  Mean   :5.273e-04   Mean   :2.699e-04   Mean   :0.000813
##  3rd Qu.:1.009e-03   3rd Qu.:4.776e-04   3rd Qu.:0.000000
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##  Max.   :1.196e-03   Max.   :5.570e-04   Max.   :0.007466
##       C192                C193                C194
##  Min.   :0.0007061   Min.   :0.001356   Min.   :0.0001423
##  1st Qu.:0.0009792   1st Qu.:0.001626   1st Qu.:0.0003202
##  Median :0.0011633   Median :0.002009   Median :0.0006634
##  Mean   :0.0012454   Mean   :0.002125   Mean   :0.0008859
##  3rd Qu.:0.0013746   3rd Qu.:0.002362   3rd Qu.:0.0012260
##  Max.   :0.0021506   Max.   :0.003859   Max.   :0.0027165
##       C195                C196                C197
##  Min.   :0.0000000   Min.   :0.001118   Min.   :0.001095
##  1st Qu.:0.0002092   1st Qu.:0.001459   1st Qu.:0.001429
##  Median :0.0004926   Median :0.001759   Median :0.001597
##  Mean   :0.0004361   Mean   :0.001701   Mean   :0.001624
##  3rd Qu.:0.0005562   3rd Qu.:0.001868   3rd Qu.:0.001724
##  Max.   :0.0009816   Max.   :0.002400   Max.   :0.002762
##       C199                C200                C201
##  Min.   :0.0009078   Min.   :0.0007464   Min.   :0.002205
##  1st Qu.:0.0011283   1st Qu.:0.0008827   1st Qu.:0.002421
##  Median :0.0014061   Median :0.0011689   Median :0.002827
##  Mean   :0.0015118   Mean   :0.0013307   Mean   :0.003021
##  3rd Qu.:0.0018515   3rd Qu.:0.0017677   3rd Qu.:0.003235
##  Max.   :0.0024839   Max.   :0.0021324   Max.   :0.005184
##       C202                C203                C204
##  Min.   :0.0006979   Min.   :0.0006971   Min.   :0.001323
##  1st Qu.:0.0008663   1st Qu.:0.0012309   1st Qu.:0.001814
##  Median :0.0012513   Median :0.0017699   Median :0.002414
##  Mean   :0.0012154   Mean   :0.0017068   Mean   :0.002395
##  3rd Qu.:0.0015239   3rd Qu.:0.0020505   3rd Qu.:0.002848
##  Max.   :0.0016801   Max.   :0.0026799   Max.   :0.003450
##       C207                C208                C209
##  Min.   :0.000e+00   Min.   :0.0007106   Min.   :0.000e+00
##  1st Qu.:0.000e+00   1st Qu.:0.0007423   1st Qu.:0.000e+00
##  Median :0.000e+00   Median :0.0007869   Median :0.000e+00
##  Mean   :1.395e-05   Mean   :0.0008208   Mean   :1.389e-05
##  3rd Qu.:0.000e+00   3rd Qu.:0.0008753   3rd Qu.:0.000e+00
##  Max.   :8.692e-05   Max.   :0.0010469   Max.   :7.987e-05
##       C213                C214                C215
##  Min.   :0.0000000   Min.   :0.0006308   Min.   :0.001148
##  1st Qu.:0.0000000   1st Qu.:0.0007496   1st Qu.:0.002157
##  Median :0.0000000   Median :0.0007859   Median :0.002323
##  Mean   :0.0000675   Mean   :0.0008276   Mean   :0.002324
##  3rd Qu.:0.0001137   3rd Qu.:0.0008816   3rd Qu.:0.002684
##  Max.   :0.0003387   Max.   :0.0010457   Max.   :0.003474
##       C216                C217                C218
##  Min.   :0.0009356   Min.   :0.0001513   Min.   :0.0008466
##  1st Qu.:0.0013085   1st Qu.:0.0005234   1st Qu.:0.0015788
##  Median :0.0014670   Median :0.0009236   Median :0.0018952
##  Mean   :0.0014220   Mean   :0.0007995   Mean   :0.0020981
##  3rd Qu.:0.0016311   3rd Qu.:0.0009941   3rd Qu.:0.0023242
##  Max.   :0.0018545   Max.   :0.0013135   Max.   :0.0039627
##       C219                C220                C221
##  Min.   :0.000e+00   Min.   :0.0003035   Min.   :0.0007427
##  1st Qu.:5.721e-05   1st Qu.:0.0005979   1st Qu.:0.0014119
##  Median :6.583e-05   Median :0.0009257   Median :0.0016004
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##  Mean   :6.723e-05   Mean   :0.0008724   Mean   :0.0017040
##  3rd Qu.:7.857e-05   3rd Qu.:0.0011560   3rd Qu.:0.0021333
##  Max.   :1.133e-04   Max.   :0.0013340   Max.   :0.0027892
##       C222                C223                C224
##  Min.   :0.002956   Min.   :0.000e+00   Min.   :0.0006256
##  1st Qu.:0.003246   1st Qu.:7.689e-05   1st Qu.:0.0008998
##  Median :0.004013   Median :4.037e-04   Median :0.0011900
##  Mean   :0.004720   Mean   :4.065e-04   Mean   :0.0011264
##  3rd Qu.:0.005544   3rd Qu.:6.366e-04   3rd Qu.:0.0012652
##  Max.   :0.009032   Max.   :9.678e-04   Max.   :0.0015851
##       C225                C226                C227
##  Min.   :0.0008237   Min.   :0.002182   Min.   :0.001989
##  1st Qu.:0.0023913   1st Qu.:0.002556   1st Qu.:0.002244
##  Median :0.0028524   Median :0.003260   Median :0.002291
##  Mean   :0.0029438   Mean   :0.003507   Mean   :0.002586
##  3rd Qu.:0.0035533   3rd Qu.:0.003984   3rd Qu.:0.002532
##  Max.   :0.0048156   Max.   :0.006667   Max.   :0.004029
##       C231                C232                C233
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0009113   1st Qu.:0.0000000   1st Qu.:0.0001515
##  Median :0.0015770   Median :0.0001128   Median :0.0001753
##  Mean   :0.0017306   Mean   :0.0003216   Mean   :0.0004226
##  3rd Qu.:0.0024079   3rd Qu.:0.0004624   3rd Qu.:0.0005211
##  Max.   :0.0036741   Max.   :0.0016200   Max.   :0.0017185
##       C234                C235                C236
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.0003314
##  1st Qu.:0.0000000   1st Qu.:0.000e+00   1st Qu.:0.0007162
##  Median :0.0000000   Median :0.000e+00   Median :0.0010564
##  Mean   :0.0001822   Mean   :1.395e-05   Mean   :0.0010370
##  3rd Qu.:0.0002313   3rd Qu.:0.000e+00   3rd Qu.:0.0013632
##  Max.   :0.0011322   Max.   :1.395e-04   Max.   :0.0017783
##       C237                C238                C239
##  Min.   :0.0004658   Min.   :0.0001933   Min.   :0.0003441
##  1st Qu.:0.0011642   1st Qu.:0.0005539   1st Qu.:0.0005041
##  Median :0.0012937   Median :0.0008196   Median :0.0005241
##  Mean   :0.0015525   Mean   :0.0010231   Mean   :0.0005108
##  3rd Qu.:0.0021172   3rd Qu.:0.0015842   3rd Qu.:0.0005457
##  Max.   :0.0031252   Max.   :0.0019186   Max.   :0.0006849
##       C240                C241                C242
##  Min.   :0.0004628   Min.   :0.0007017   Min.   :0.001371
##  1st Qu.:0.0010675   1st Qu.:0.0008367   1st Qu.:0.001466
##  Median :0.0013203   Median :0.0010237   Median :0.002035
##  Mean   :0.0014442   Mean   :0.0011573   Mean   :0.002051
##  3rd Qu.:0.0017297   3rd Qu.:0.0012284   3rd Qu.:0.002541
##  Max.   :0.0029728   Max.   :0.0021162   Max.   :0.003011
##       C243                C244                C247
##  Min.   :0.0004764   Min.   :0.0008321   Min.   :0.0003487
##  1st Qu.:0.0009372   1st Qu.:0.0011085   1st Qu.:0.0004870
##  Median :0.0011809   Median :0.0011946   Median :0.0005370
##  Mean   :0.0012912   Mean   :0.0012193   Mean   :0.0006054
##  3rd Qu.:0.0016491   3rd Qu.:0.0012493   3rd Qu.:0.0007368
##  Max.   :0.0024285   Max.   :0.0018532   Max.   :0.0010257
##       C248                C249                C250
##  Min.   :0.0004346   Min.   :0.0000000   Min.   :0.0000000
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##  1st Qu.:0.0004456   1st Qu.:0.0000000   1st Qu.:0.0000000
##  Median :0.0005228   Median :0.0000000   Median :0.0000000
##  Mean   :0.0005425   Mean   :0.0001459   Mean   :0.0014805
##  3rd Qu.:0.0006249   3rd Qu.:0.0000000   3rd Qu.:0.0007405
##  Max.   :0.0007008   Max.   :0.0009861   Max.   :0.0080851
##       C252                C253                C256
##  Min.   :0.000e+00   Min.   :0.0002128   Min.   :0.0000000
##  1st Qu.:5.989e-05   1st Qu.:0.0002721   1st Qu.:0.0001004
##  Median :3.893e-04   Median :0.0002948   Median :0.0001673
##  Mean   :4.591e-04   Mean   :0.0002957   Mean   :0.0001605
##  3rd Qu.:7.979e-04   3rd Qu.:0.0003141   3rd Qu.:0.0002537
##  Max.   :1.167e-03   Max.   :0.0003935   Max.   :0.0002850
##       C257                C258                C260
##  Min.   :0.0002292   Min.   :0.001724   Min.   :0.0000000
##  1st Qu.:0.0002878   1st Qu.:0.002642   1st Qu.:0.0001223
##  Median :0.0003483   Median :0.003617   Median :0.0003092
##  Mean   :0.0003534   Mean   :0.006329   Mean   :0.0005255
##  3rd Qu.:0.0004177   3rd Qu.:0.004697   3rd Qu.:0.0006359
##  Max.   :0.0004619   Max.   :0.031214   Max.   :0.0021979
##       C261               C264                C265
##  Min.   :0.000363   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.001310   1st Qu.:0.000e+00   1st Qu.:2.374e-05
##  Median :0.001509   Median :5.193e-05   Median :1.089e-04
##  Mean   :0.001489   Mean   :3.891e-03   Mean   :1.255e-04
##  3rd Qu.:0.001860   3rd Qu.:1.948e-03   3rd Qu.:1.605e-04
##  Max.   :0.002330   Max.   :2.711e-02   Max.   :4.209e-04
##       C266               C267              C268
##  Min.   :0.000000   Min.   :0.00000   Min.   :0.0000000
##  1st Qu.:0.001549   1st Qu.:0.01217   1st Qu.:0.0000000
##  Median :0.008304   Median :0.01414   Median :0.0004294
##  Mean   :0.008330   Mean   :0.02355   Mean   :0.0030648
##  3rd Qu.:0.011790   3rd Qu.:0.01791   3rd Qu.:0.0035487
##  Max.   :0.021954   Max.   :0.12171   Max.   :0.0118815
##       C269                C286                C288
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.000000
##  1st Qu.:0.0000000   1st Qu.:0.0005317   1st Qu.:0.000000
##  Median :0.0000000   Median :0.0027747   Median :0.001554
##  Mean   :0.0004394   Mean   :0.0023169   Mean   :0.005210
##  3rd Qu.:0.0000000   3rd Qu.:0.0038848   3rd Qu.:0.007550
##  Max.   :0.0043944   Max.   :0.0045192   Max.   :0.023915
##       C290                C291                C292
##  Min.   :0.0004500   Min.   :0.000000   Min.   :0.0000000
##  1st Qu.:0.0005640   1st Qu.:0.001588   1st Qu.:0.0002463
##  Median :0.0005993   Median :0.002339   Median :0.0003202
##  Mean   :0.0006913   Mean   :0.001996   Mean   :0.0003296
##  3rd Qu.:0.0008228   3rd Qu.:0.002442   3rd Qu.:0.0004637
##  Max.   :0.0012220   Max.   :0.003964   Max.   :0.0005245
##       C293               C294                C296
##  Min.   :0.000000   Min.   :0.0000000   Min.   :0.001017
##  1st Qu.:0.001798   1st Qu.:0.0000000   1st Qu.:0.001252
##  Median :0.011945   Median :0.0000000   Median :0.001528
##  Mean   :0.017434   Mean   :0.0002096   Mean   :0.001563
##  3rd Qu.:0.033954   3rd Qu.:0.0000000   3rd Qu.:0.001650
##  Max.   :0.044610   Max.   :0.0020960   Max.   :0.002354
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##       C297              C300              C301
##  Min.   :0.001734   Min.   :0.0009093   Min.   :0.0008364
##  1st Qu.:0.002028   1st Qu.:0.0015137   1st Qu.:0.0018925
##  Median :0.002546   Median :0.0016319   Median :0.0021733
##  Mean   :0.002593   Mean   :0.0017145   Mean   :0.0024579
##  3rd Qu.:0.002990   3rd Qu.:0.0020743   3rd Qu.:0.0031493
##  Max.   :0.003858   Max.   :0.0025052   Max.   :0.0042289
##       C303               C304               C305
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0007066
##  1st Qu.:0.0000822   1st Qu.:0.0006477   1st Qu.:0.0008303
##  Median :0.0003116   Median :0.0011323   Median :0.0010481
##  Mean   :0.0005473   Mean   :0.0009965   Mean   :0.0010779
##  3rd Qu.:0.0006114   3rd Qu.:0.0013911   3rd Qu.:0.0013256
##  Max.   :0.0025734   Max.   :0.0020951   Max.   :0.0015463
##       C306               C307               C308
##  Min.   :0.000e+00   Min.   :0.0004612   Min.   :0.0009186
##  1st Qu.:0.000e+00   1st Qu.:0.0007798   1st Qu.:0.0019643
##  Median :0.000e+00   Median :0.0009700   Median :0.0023146
##  Mean   :1.115e-05   Mean   :0.0009454   Mean   :0.0025767
##  3rd Qu.:0.000e+00   3rd Qu.:0.0011367   3rd Qu.:0.0023773
##  Max.   :1.115e-04   Max.   :0.0012924   Max.   :0.0070375
##       C309               C310              C312
##  Min.   :0.0000000   Min.   :0.001619   Min.   :0.000e+00
##  1st Qu.:0.0000000   1st Qu.:0.001742   1st Qu.:2.012e-05
##  Median :0.0000000   Median :0.001878   Median :1.061e-04
##  Mean   :0.0002204   Mean   :0.002280   Mean   :1.221e-04
##  3rd Qu.:0.0002389   3rd Qu.:0.002657   3rd Qu.:1.485e-04
##  Max.   :0.0013539   Max.   :0.004192   Max.   :3.673e-04
##       C313               C314              C315
##  Min.   :0.0000000   Min.   :0.001805   Min.   :0.0009766
##  1st Qu.:0.0000000   1st Qu.:0.002438   1st Qu.:0.0018505
##  Median :0.0000000   Median :0.002892   Median :0.0026521
##  Mean   :0.0000493   Mean   :0.003083   Mean   :0.0024921
##  3rd Qu.:0.0000000   3rd Qu.:0.003398   3rd Qu.:0.0031030
##  Max.   :0.0003034   Max.   :0.005030   Max.   :0.0040858
##       C316               C317               C318
##  Min.   :0.0005592   Min.   :0.000e+00   Min.   :0.0005150
##  1st Qu.:0.0005945   1st Qu.:0.000e+00   1st Qu.:0.0005921
##  Median :0.0006680   Median :0.000e+00   Median :0.0006093
##  Mean   :0.0008016   Mean   :7.633e-05   Mean   :0.0007185
##  3rd Qu.:0.0008533   3rd Qu.:0.000e+00   3rd Qu.:0.0008257
##  Max.   :0.0015814   Max.   :4.303e-04   Max.   :0.0011148
##       C319              C320               C322
##  Min.   :0.001514   Min.   :0.0006455   Min.   :4.758e-05
##  1st Qu.:0.002053   1st Qu.:0.0008031   1st Qu.:7.476e-05
##  Median :0.002184   Median :0.0008683   Median :1.474e-04
##  Mean   :0.002383   Mean   :0.0009330   Mean   :1.564e-04
##  3rd Qu.:0.002564   3rd Qu.:0.0010054   3rd Qu.:2.255e-04
##  Max.   :0.003685   Max.   :0.0015020   Max.   :3.369e-04
##       C323              C325               C326
##  Min.   :0.000000   Min.   :9.245e-05   Min.   :0.0003762
##  1st Qu.:0.001195   1st Qu.:1.055e-03   1st Qu.:0.0003867
##  Median :0.002402   Median :1.362e-03   Median :0.0004561
##  Mean   :0.002269   Mean   :1.454e-03   Mean   :0.0004599
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##  3rd Qu.:0.003637   3rd Qu.:2.048e-03   3rd Qu.:0.0004894
##  Max.   :0.004698   Max.   :2.748e-03   Max.   :0.0006446
##       C327                C328                C329
##  Min.   :0.000e+00   Min.   :0.0003975   Min.   :0.000568
##  1st Qu.:1.724e-05   1st Qu.:0.0008343   1st Qu.:0.001269
##  Median :3.830e-04   Median :0.0011037   Median :0.002139
##  Mean   :5.019e-04   Mean   :0.0009817   Mean   :0.002212
##  3rd Qu.:6.489e-04   3rd Qu.:0.0011523   3rd Qu.:0.003103
##  Max.   :2.092e-03   Max.   :0.0012774   Max.   :0.003967
##       C330                C331                C332
##  Min.   :0.0007711   Min.   :0.0000000   Min.   :0.001571
##  1st Qu.:0.0009777   1st Qu.:0.0000000   1st Qu.:0.002157
##  Median :0.0010670   Median :0.0001637   Median :0.002659
##  Mean   :0.0011872   Mean   :0.0005383   Mean   :0.002572
##  3rd Qu.:0.0012795   3rd Qu.:0.0010162   3rd Qu.:0.002800
##  Max.   :0.0018430   Max.   :0.0022180   Max.   :0.003570
##       C333                C334                C335
##  Min.   :0.0001937   Min.   :0.0009573   Min.   :0.0009396
##  1st Qu.:0.0001974   1st Qu.:0.0018863   1st Qu.:0.0014215
##  Median :0.0002377   Median :0.0022530   Median :0.0017303
##  Mean   :0.0002549   Mean   :0.0024272   Mean   :0.0021504
##  3rd Qu.:0.0003115   3rd Qu.:0.0029362   3rd Qu.:0.0027207
##  Max.   :0.0003582   Max.   :0.0040743   Max.   :0.0048883
##       C336               C337                C339
##  Min.   :0.001066   Min.   :0.0001386   Min.   :0.000e+00
##  1st Qu.:0.001175   1st Qu.:0.0017538   1st Qu.:0.000e+00
##  Median :0.001399   Median :0.0024330   Median :2.691e-05
##  Mean   :0.001513   Mean   :0.0023546   Mean   :5.007e-05
##  3rd Qu.:0.001730   3rd Qu.:0.0028081   3rd Qu.:6.744e-05
##  Max.   :0.002325   Max.   :0.0050151   Max.   :1.988e-04
##       C340               C341                C342
##  Min.   :0.000890   Min.   :0.000e+00   Min.   :0.0000000
##  1st Qu.:0.001266   1st Qu.:0.000e+00   1st Qu.:0.0001940
##  Median :0.001984   Median :0.000e+00   Median :0.0011645
##  Mean   :0.001871   Mean   :3.244e-05   Mean   :0.0009562
##  3rd Qu.:0.002396   3rd Qu.:0.000e+00   3rd Qu.:0.0015639
##  Max.   :0.002810   Max.   :2.359e-04   Max.   :0.0018297
##       C343               C344               C345
##  Min.   :0.001147   Min.   :0.003442   Min.   :0.000e+00
##  1st Qu.:0.001492   1st Qu.:0.004604   1st Qu.:0.000e+00
##  Median :0.002034   Median :0.005082   Median :0.000e+00
##  Mean   :0.002060   Mean   :0.005247   Mean   :2.943e-05
##  3rd Qu.:0.002282   3rd Qu.:0.005753   3rd Qu.:0.000e+00
##  Max.   :0.003428   Max.   :0.007688   Max.   :2.291e-04
##       C347                C348                C349
##  Min.   :0.0007094   Min.   :0.0007266   Min.   :0.0000000
##  1st Qu.:0.0008520   1st Qu.:0.0008171   1st Qu.:0.0000000
##  Median :0.0010456   Median :0.0011175   Median :0.0003458
##  Mean   :0.0011707   Mean   :0.0011530   Mean   :0.0005165
##  3rd Qu.:0.0011648   3rd Qu.:0.0012636   3rd Qu.:0.0007979
##  Max.   :0.0026540   Max.   :0.0023345   Max.   :0.0021360
##       C350                C351                C352
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.000838
##  1st Qu.:0.0005550   1st Qu.:0.0002055   1st Qu.:0.001293
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##  Median :0.0006741   Median :0.0002919   Median :0.001532
##  Mean   :0.0008043   Mean   :0.0002469   Mean   :0.001535
##  3rd Qu.:0.0012877   3rd Qu.:0.0003463   3rd Qu.:0.001832
##  Max.   :0.0015127   Max.   :0.0003859   Max.   :0.002192
##       C353                C354                C356
##  Min.   :0.0003735   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.0004732   1st Qu.:0.000e+00   1st Qu.:0.000e+00
##  Median :0.0005353   Median :0.000e+00   Median :0.000e+00
##  Mean   :0.0006254   Mean   :5.476e-05   Mean   :2.621e-05
##  3rd Qu.:0.0006310   3rd Qu.:8.467e-05   3rd Qu.:0.000e+00
##  Max.   :0.0013635   Max.   :2.723e-04   Max.   :2.621e-04
##       C359                C360               C361
##  Min.   :0.0000000   Min.   :0.000000   Min.   :7.495e-05
##  1st Qu.:0.0003293   1st Qu.:0.001060   1st Qu.:9.250e-04
##  Median :0.0003860   Median :0.001331   Median :1.646e-03
##  Mean   :0.0005070   Mean   :0.001290   Mean   :1.828e-03
##  3rd Qu.:0.0007316   3rd Qu.:0.001670   3rd Qu.:2.475e-03
##  Max.   :0.0012884   Max.   :0.002374   Max.   :5.051e-03
##       C362                C364                C365
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0000000   1st Qu.:0.0005024   1st Qu.:0.0009945
##  Median :0.0001379   Median :0.0007686   Median :0.0030244
##  Mean   :0.0003360   Mean   :0.0009140   Mean   :0.0027882
##  3rd Qu.:0.0006820   3rd Qu.:0.0011898   3rd Qu.:0.0041879
##  Max.   :0.0010437   Max.   :0.0023209   Max.   :0.0057159
##       C366                C367                C368
##  Min.   :0.0000000   Min.   :0.0005098   Min.   :0.0004768
##  1st Qu.:0.0007335   1st Qu.:0.0014861   1st Qu.:0.0005676
##  Median :0.0011053   Median :0.0020198   Median :0.0012793
##  Mean   :0.0012799   Mean   :0.0018125   Mean   :0.0011923
##  3rd Qu.:0.0013097   3rd Qu.:0.0022186   3rd Qu.:0.0016109
##  Max.   :0.0043397   Max.   :0.0027089   Max.   :0.0020150
##       C369               C374                C375
##  Min.   :0.001183   Min.   :0.0000000   Min.   :0.000e+00
##  1st Qu.:0.001410   1st Qu.:0.0000000   1st Qu.:2.245e-05
##  Median :0.001717   Median :0.0000000   Median :1.970e-04
##  Mean   :0.002157   Mean   :0.0002164   Mean   :1.900e-04
##  3rd Qu.:0.002606   3rd Qu.:0.0000000   3rd Qu.:3.318e-04
##  Max.   :0.004139   Max.   :0.0019057   Max.   :4.148e-04
##       C376                C377                C378
##  Min.   :0.001543   Min.   :0.0004918   Min.   :0.0003574
##  1st Qu.:0.002281   1st Qu.:0.0011680   1st Qu.:0.0006439
##  Median :0.002783   Median :0.0017431   Median :0.0010643
##  Mean   :0.003029   Mean   :0.0017066   Mean   :0.0015399
##  3rd Qu.:0.003748   3rd Qu.:0.0022113   3rd Qu.:0.0014499
##  Max.   :0.004886   Max.   :0.0028173   Max.   :0.0056218
##       C379                C380               C381
##  Min.   :0.0004798   Min.   :0.001442   Min.   :0.0000000
##  1st Qu.:0.0009407   1st Qu.:0.001613   1st Qu.:0.0002496
##  Median :0.0016515   Median :0.001845   Median :0.0011171
##  Mean   :0.0014527   Mean   :0.001893   Mean   :0.0013298
##  3rd Qu.:0.0020034   3rd Qu.:0.002092   3rd Qu.:0.0014697
##  Max.   :0.0022055   Max.   :0.002449   Max.   :0.0049392
##       C382                C383               C384
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##  Min.   :0.001527   Min.   :9.272e-05   Min.   :6.209e-05
##  1st Qu.:0.001772   1st Qu.:5.446e-04   1st Qu.:2.174e-04
##  Median :0.001945   Median :8.216e-04   Median :2.703e-04
##  Mean   :0.002255   Mean   :8.436e-04   Mean   :3.152e-04
##  3rd Qu.:0.002614   3rd Qu.:1.198e-03   3rd Qu.:4.144e-04
##  Max.   :0.003884   Max.   :1.479e-03   Max.   :6.157e-04
##       C385               C386               C387
##  Min.   :0.001430   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.001604   1st Qu.:5.596e-05   1st Qu.:0.000e+00
##  Median :0.001767   Median :7.863e-05   Median :0.000e+00
##  Mean   :0.001869   Mean   :8.995e-05   Mean   :1.005e-05
##  3rd Qu.:0.002152   3rd Qu.:1.232e-04   3rd Qu.:0.000e+00
##  Max.   :0.002446   Max.   :1.977e-04   Max.   :1.005e-04
##       C388                C389                C390
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.0006941
##  1st Qu.:0.0002896   1st Qu.:0.000e+00   1st Qu.:0.0012387
##  Median :0.0004932   Median :0.000e+00   Median :0.0019725
##  Mean   :0.0007627   Mean   :3.648e-05   Mean   :0.0018121
##  3rd Qu.:0.0011139   3rd Qu.:0.000e+00   3rd Qu.:0.0024477
##  Max.   :0.0023592   Max.   :3.011e-04   Max.   :0.0028624
##       C391               C392               C393
##  Min.   :0.000000   Min.   :0.0000000   Min.   :0.0009236
##  1st Qu.:0.002075   1st Qu.:0.0002517   1st Qu.:0.0014737
##  Median :0.002507   Median :0.0005189   Median :0.0016633
##  Mean   :0.002433   Mean   :0.0004897   Mean   :0.0017348
##  3rd Qu.:0.003100   3rd Qu.:0.0007477   3rd Qu.:0.0019924
##  Max.   :0.004048   Max.   :0.0010019   Max.   :0.0026486
##       C394                C395                C400
##  Min.   :0.0008084   Min.   :0.000e+00   Min.   :0.0004026
##  1st Qu.:0.0013816   1st Qu.:0.000e+00   1st Qu.:0.0008451
##  Median :0.0020463   Median :0.000e+00   Median :0.0017352
##  Mean   :0.0023521   Mean   :8.572e-05   Mean   :0.0016668
##  3rd Qu.:0.0029535   3rd Qu.:1.664e-04   3rd Qu.:0.0020720
##  Max.   :0.0050417   Max.   :3.246e-04   Max.   :0.0037149
##       C401               C402               C404
##  Min.   :0.0006796   Min.   :0.0008877   Min.   :0.000e+00
##  1st Qu.:0.0012319   1st Qu.:0.0010609   1st Qu.:0.000e+00
##  Median :0.0015096   Median :0.0011859   Median :0.000e+00
##  Mean   :0.0014344   Mean   :0.0016930   Mean   :3.581e-05
##  3rd Qu.:0.0017381   3rd Qu.:0.0019638   3rd Qu.:0.000e+00
##  Max.   :0.0019829   Max.   :0.0041280   Max.   :2.980e-04
##       C408               C409               C411
##  Min.   :0.0002379   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.0004764   1st Qu.:5.493e-05   1st Qu.:0.000e+00
##  Median :0.0008504   Median :3.708e-04   Median :0.000e+00
##  Mean   :0.0007911   Mean   :3.594e-04   Mean   :4.214e-05
##  3rd Qu.:0.0010042   3rd Qu.:5.404e-04   3rd Qu.:0.000e+00
##  Max.   :0.0013377   Max.   :9.736e-04   Max.   :2.538e-04
##       C415               C417               C418
##  Min.   :0.000e+00   Min.   :0.0009492   Min.   :0.0000000
##  1st Qu.:9.966e-05   1st Qu.:0.0010729   1st Qu.:0.0003203
##  Median :3.207e-04   Median :0.0012829   Median :0.0004703
##  Mean   :3.707e-04   Mean   :0.0012656   Mean   :0.0006044
##  3rd Qu.:5.808e-04   3rd Qu.:0.0013986   3rd Qu.:0.0009302
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##  Max.   :9.113e-04   Max.   :0.0016126   Max.   :0.0013466
##       C420                C421                C424
##  Min.   :7.838e-05   Min.   :0.0002804   Min.   :0.000e+00
##  1st Qu.:1.330e-04   1st Qu.:0.0005840   1st Qu.:0.000e+00
##  Median :1.788e-04   Median :0.0009267   Median :0.000e+00
##  Mean   :2.006e-04   Mean   :0.0009168   Mean   :2.687e-05
##  3rd Qu.:2.623e-04   3rd Qu.:0.0011862   3rd Qu.:0.000e+00
##  Max.   :3.833e-04   Max.   :0.0016065   Max.   :2.687e-04
##       C426                C427                C428
##  Min.   :0.000e+00   Min.   :0.0000000   Min.   :0.001283
##  1st Qu.:0.000e+00   1st Qu.:0.0003383   1st Qu.:0.001500
##  Median :0.000e+00   Median :0.0005971   Median :0.001691
##  Mean   :3.393e-05   Mean   :0.0007505   Mean   :0.001668
##  3rd Qu.:4.792e-05   3rd Qu.:0.0012317   3rd Qu.:0.001871
##  Max.   :1.837e-04   Max.   :0.0016667   Max.   :0.001944
##       C431                C434                C435
##  Min.   :0.000e+00   Min.   :0.0001466   Min.   :0.0001068
##  1st Qu.:0.000e+00   1st Qu.:0.0002896   1st Qu.:0.0002669
##  Median :0.000e+00   Median :0.0005457   Median :0.0010587
##  Mean   :3.687e-05   Mean   :0.0005862   Mean   :0.0008166
##  3rd Qu.:5.185e-05   3rd Qu.:0.0007329   3rd Qu.:0.0011058
##  Max.   :2.296e-04   Max.   :0.0012589   Max.   :0.0017208
##       C436                C437                C439
##  Min.   :0.0003901   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0006706   1st Qu.:0.0000000   1st Qu.:0.0000000
##  Median :0.0007600   Median :0.0000000   Median :0.0001543
##  Mean   :0.0008251   Mean   :0.0001014   Mean   :0.0003792
##  3rd Qu.:0.0010242   3rd Qu.:0.0000000   3rd Qu.:0.0005378
##  Max.   :0.0012949   Max.   :0.0005691   Max.   :0.0013688
##       C441                C442                C443
##  Min.   :0.0000000   Min.   :0.0007588   Min.   :6.263e-05
##  1st Qu.:0.0004033   1st Qu.:0.0009079   1st Qu.:7.642e-04
##  Median :0.0005999   Median :0.0010248   Median :1.134e-03
##  Mean   :0.0008897   Mean   :0.0012915   Mean   :1.041e-03
##  3rd Qu.:0.0013373   3rd Qu.:0.0017296   3rd Qu.:1.279e-03
##  Max.   :0.0025965   Max.   :0.0021982   Max.   :1.889e-03
##       C444                C447               C448
##  Min.   :0.0000000   Min.   :0.000000   Min.   :0.000000
##  1st Qu.:0.0000000   1st Qu.:0.000000   1st Qu.:0.000000
##  Median :0.0000000   Median :0.000000   Median :0.000000
##  Mean   :0.0002107   Mean   :0.005518   Mean   :0.007856
##  3rd Qu.:0.0000000   3rd Qu.:0.000000   3rd Qu.:0.014884
##  Max.   :0.0018851   Max.   :0.045796   Max.   :0.032917
##       C449                C450                C451
##  Min.   :0.000e+00   Min.   :0.0003065   Min.   :0.0003051
##  1st Qu.:0.000e+00   1st Qu.:0.0003589   1st Qu.:0.0004588
##  Median :0.000e+00   Median :0.0004630   Median :0.0006187
##  Mean   :3.889e-04   Mean   :0.0004794   Mean   :0.0005920
##  3rd Qu.:8.436e-05   3rd Qu.:0.0005966   3rd Qu.:0.0007082
##  Max.   :3.663e-03   Max.   :0.0006928   Max.   :0.0008671
##       C453                C454                C455
##  Min.   :0.000e+00   Min.   :0.0003518   Min.   :0.00000
##  1st Qu.:1.922e-05   1st Qu.:0.0004190   1st Qu.:0.01087
##  Median :1.224e-04   Median :0.0004473   Median :0.01690
```

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##  Mean   :9.402e-05   Mean   :0.0005141   Mean   :0.02208
##  3rd Qu.:1.521e-04   3rd Qu.:0.0005524   3rd Qu.:0.02417
##  Max.   :1.615e-04   Max.   :0.0009188   Max.   :0.07799
##       C456                C457                C459
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.0000000   1st Qu.:5.343e-05   1st Qu.:0.000e+00
##  Median :0.0000000   Median :4.021e-04   Median :9.123e-05
##  Mean   :0.0001732   Mean   :1.267e-03   Mean   :5.581e-04
##  3rd Qu.:0.0000000   3rd Qu.:1.398e-03   3rd Qu.:3.527e-04
##  Max.   :0.0008926   Max.   :5.455e-03   Max.   :3.598e-03
##       C460                C461                C496
##  Min.   :0.007891   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.048626   1st Qu.:0.0001515   1st Qu.:0.0001210
##  Median :0.074999   Median :0.0007644   Median :0.0004024
##  Mean   :0.077108   Mean   :0.0018114   Mean   :0.0003687
##  3rd Qu.:0.091516   3rd Qu.:0.0022415   3rd Qu.:0.0005895
##  Max.   :0.157810   Max.   :0.0071185   Max.   :0.0007603
##       C498                C499                C500
##  Min.   :0.000000   Min.   :0.0003360   Min.   :0.000e+00
##  1st Qu.:0.000000   1st Qu.:0.0009629   1st Qu.:5.874e-05
##  Median :0.002579   Median :0.0012400   Median :1.289e-04
##  Mean   :0.005347   Mean   :0.0010790   Mean   :1.950e-04
##  3rd Qu.:0.010600   3rd Qu.:0.0013676   3rd Qu.:2.970e-04
##  Max.   :0.015529   Max.   :0.0013935   Max.   :6.266e-04
##       C506                C508                C509
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.0000000
##  1st Qu.:0.0001172   1st Qu.:0.000e+00   1st Qu.:0.0000000
##  Median :0.0001515   Median :3.188e-05   Median :0.0000000
##  Mean   :0.0001483   Mean   :1.150e-04   Mean   :0.0001871
##  3rd Qu.:0.0001680   3rd Qu.:2.538e-04   3rd Qu.:0.0000000
##  Max.   :0.0002851   Max.   :3.696e-04   Max.   :0.0018705
##       C510                C511                C512
##  Min.   :0.0008048   Min.   :0.0000000   Min.   :0.001614
##  1st Qu.:0.0014433   1st Qu.:0.0002706   1st Qu.:0.002007
##  Median :0.0015969   Median :0.0003979   Median :0.002161
##  Mean   :0.0016933   Mean   :0.0004716   Mean   :0.002350
##  3rd Qu.:0.0019651   3rd Qu.:0.0005726   3rd Qu.:0.002743
##  Max.   :0.0026455   Max.   :0.0014750   Max.   :0.003215
##       C513                C514                C516
##  Min.   :0.000000   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.001244   1st Qu.:0.0000000   1st Qu.:0.0000000
##  Median :0.001735   Median :0.0000000   Median :0.0000000
##  Mean   :0.001561   Mean   :0.0004843   Mean   :0.0001751
##  3rd Qu.:0.002057   3rd Qu.:0.0009115   3rd Qu.:0.0000000
##  Max.   :0.002663   Max.   :0.0018642   Max.   :0.0010692
##       C517                C518                C519
##  Min.   :0.0001717   Min.   :0.0001938   Min.   :0.000e+00
##  1st Qu.:0.0004397   1st Qu.:0.0005208   1st Qu.:0.000e+00
##  Median :0.0007667   Median :0.0006362   Median :9.403e-05
##  Mean   :0.0007093   Mean   :0.0006335   Mean   :1.519e-04
##  3rd Qu.:0.0009949   3rd Qu.:0.0006977   3rd Qu.:1.931e-04
##  Max.   :0.0011133   Max.   :0.0012130   Max.   :6.537e-04
##       C520                C521                C523
##  Min.   :0.0004864   Min.   :0.001968   Min.   :0.002486
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##  1st Qu.:0.0006309   1st Qu.:0.002643   1st Qu.:0.002841
##  Median :0.0007636   Median :0.002841   Median :0.003344
##  Mean   :0.0008269   Mean   :0.002922   Mean   :0.003600
##  3rd Qu.:0.0010545   3rd Qu.:0.003443   3rd Qu.:0.004092
##  Max.   :0.0012095   Max.   :0.003791   Max.   :0.006049
##       C525                C526                C527
##  Min.   :0.001431   Min.   :0.0002665   Min.   :0.0002602
##  1st Qu.:0.001886   1st Qu.:0.0003108   1st Qu.:0.0008664
##  Median :0.002095   Median :0.0003987   Median :0.0014514
##  Mean   :0.002547   Mean   :0.0004098   Mean   :0.0014809
##  3rd Qu.:0.003061   3rd Qu.:0.0004609   3rd Qu.:0.0018815
##  Max.   :0.004321   Max.   :0.0006951   Max.   :0.0028312
##       C528                C529                C530
##  Min.   :0.001150   Min.   :0.0008069   Min.   :0.001340
##  1st Qu.:0.001966   1st Qu.:0.0012396   1st Qu.:0.001565
##  Median :0.002517   Median :0.0016767   Median :0.001979
##  Mean   :0.003087   Mean   :0.0022148   Mean   :0.002004
##  3rd Qu.:0.004315   3rd Qu.:0.0034490   3rd Qu.:0.002209
##  Max.   :0.005667   Max.   :0.0039788   Max.   :0.003013
##       C531                C532                C535
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.0006721
##  1st Qu.:7.247e-05   1st Qu.:7.768e-05   1st Qu.:0.0007753
##  Median :1.495e-04   Median :1.212e-04   Median :0.0009430
##  Mean   :1.265e-04   Mean   :1.338e-04   Mean   :0.0009608
##  3rd Qu.:2.008e-04   3rd Qu.:1.965e-04   3rd Qu.:0.0011576
##  Max.   :2.144e-04   Max.   :2.791e-04   Max.   :0.0013548
##       C536                C537                C538
##  Min.   :0.0001813   Min.   :0.000000   Min.   :0.0003788
##  1st Qu.:0.0003323   1st Qu.:0.001086   1st Qu.:0.0015247
##  Median :0.0003771   Median :0.001784   Median :0.0018546
##  Mean   :0.0003965   Mean   :0.001603   Mean   :0.0017837
##  3rd Qu.:0.0004830   3rd Qu.:0.002216   3rd Qu.:0.0020395
##  Max.   :0.0007051   Max.   :0.002905   Max.   :0.0028634
##       C539                C540                C541
##  Min.   :0.001691   Min.   :0.0003205   Min.   :9.074e-05
##  1st Qu.:0.001921   1st Qu.:0.0013016   1st Qu.:4.333e-04
##  Median :0.002211   Median :0.0020202   Median :5.110e-04
##  Mean   :0.002349   Mean   :0.0017997   Mean   :5.430e-04
##  3rd Qu.:0.002871   3rd Qu.:0.0021950   3rd Qu.:6.812e-04
##  Max.   :0.003207   Max.   :0.0027817   Max.   :1.130e-03
##       C542                C543                C544
##  Min.   :0.0000000   Min.   :0.000000   Min.   :0.0004151
##  1st Qu.:0.0001325   1st Qu.:0.001817   1st Qu.:0.0006404
##  Median :0.0006517   Median :0.002185   Median :0.0016211
##  Mean   :0.0005962   Mean   :0.001903   Mean   :0.0017365
##  3rd Qu.:0.0007114   3rd Qu.:0.002479   3rd Qu.:0.0027282
##  Max.   :0.0014427   Max.   :0.002961   Max.   :0.0034514
##       C545                C546                C549
##  Min.   :0.000000   Min.   :0.000e+00   Min.   :0.0005958
##  1st Qu.:0.000832   1st Qu.:3.601e-05   1st Qu.:0.0006719
##  Median :0.001128   Median :5.676e-04   Median :0.0007867
##  Mean   :0.001083   Mean   :6.703e-04   Mean   :0.0008869
##  3rd Qu.:0.001539   3rd Qu.:8.834e-04   3rd Qu.:0.0010620
##  Max.   :0.001724   Max.   :2.393e-03   Max.   :0.0014234
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##       C550               C551               C552          
##  Min.   :0.000000   Min.   :0.002144   Min.   :0.0000000  
##  1st Qu.:0.001008   1st Qu.:0.003066   1st Qu.:0.0001728  
##  Median :0.001289   Median :0.003649   Median :0.0002438  
##  Mean   :0.001410   Mean   :0.003496   Mean   :0.0002221  
##  3rd Qu.:0.001999   3rd Qu.:0.003897   3rd Qu.:0.0003111  
##  Max.   :0.002341   Max.   :0.005084   Max.   :0.0003512  
##       C553               C554                C555          
##  Min.   :0.000558   Min.   :0.0007843   Min.   :6.510e-05  
##  1st Qu.:0.001188   1st Qu.:0.0011232   1st Qu.:8.909e-05  
##  Median :0.001276   Median :0.0016170   Median :9.574e-05  
##  Mean   :0.001319   Mean   :0.0015492   Mean   :9.796e-05  
##  3rd Qu.:0.001582   3rd Qu.:0.0018808   3rd Qu.:1.145e-04  
##  Max.   :0.002037   Max.   :0.0024737   Max.   :1.235e-04  
##       C556                C557                C558          
##  Min.   :0.000e+00   Min.   :0.0000000   Min.   :0.0002809  
##  1st Qu.:7.475e-05   1st Qu.:0.0000000   1st Qu.:0.0008200  
##  Median :7.842e-05   Median :0.0000000   Median :0.0009183  
##  Mean   :8.848e-05   Mean   :0.0002282   Mean   :0.0009380  
##  3rd Qu.:1.025e-04   3rd Qu.:0.0002293   3rd Qu.:0.0011774  
##  Max.   :1.864e-04   Max.   :0.0011761   Max.   :0.0014475  
##       C559               C560               C561          
##  Min.   :0.0000000   Min.   :0.0006459   Min.   :0.001388  
##  1st Qu.:0.0000000   1st Qu.:0.0010610   1st Qu.:0.002959  
##  Median :0.0000000   Median :0.0015043   Median :0.004854  
##  Mean   :0.0001682   Mean   :0.0015306   Mean   :0.004340  
##  3rd Qu.:0.0003080   3rd Qu.:0.0019906   3rd Qu.:0.005447  
##  Max.   :0.0007649   Max.   :0.0025459   Max.   :0.007310  
##       C562               C563               C566          
##  Min.   :0.0000000   Min.   :0.000475   Min.   :0.0000000  
##  1st Qu.:0.0002848   1st Qu.:0.001170   1st Qu.:0.0004345  
##  Median :0.0004691   Median :0.001388   Median :0.0005898  
##  Mean   :0.0007216   Mean   :0.001595   Mean   :0.0006700  
##  3rd Qu.:0.0009600   3rd Qu.:0.001995   3rd Qu.:0.0007734  
##  Max.   :0.0022667   Max.   :0.003043   Max.   :0.0015840  
##       C568               C569               C570          
##  Min.   :0.0004817   Min.   :0.0003922   Min.   :0.0002518  
##  1st Qu.:0.0006111   1st Qu.:0.0005105   1st Qu.:0.0003225  
##  Median :0.0007102   Median :0.0005998   Median :0.0003690  
##  Mean   :0.0007142   Mean   :0.0006432   Mean   :0.0004040  
##  3rd Qu.:0.0008040   3rd Qu.:0.0007071   3rd Qu.:0.0005175  
##  Max.   :0.0010147   Max.   :0.0010418   Max.   :0.0005587  
##       C573               C574               C575          
##  Min.   :0.001275   Min.   :0.0000000   Min.   :0.000e+00  
##  1st Qu.:0.001374   1st Qu.:0.0003783   1st Qu.:0.000e+00  
##  Median :0.001542   Median :0.0012646   Median :0.000e+00  
##  Mean   :0.001594   Mean   :0.0014855   Mean   :2.898e-05  
##  3rd Qu.:0.001695   3rd Qu.:0.0024552   3rd Qu.:0.000e+00  
##  Max.   :0.002296   Max.   :0.0035953   Max.   :2.898e-04  
##       C576               C577                C579          
##  Min.   :0.0001085   Min.   :0.000e+00   Min.   :9.705e-05  
##  1st Qu.:0.0001492   1st Qu.:5.548e-05   1st Qu.:6.414e-04  
##  Median :0.0001927   Median :1.575e-04   Median :1.400e-03  
##  Mean   :0.0002020   Mean   :1.329e-04   Mean   :1.239e-03
```

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##  3rd Qu.:0.0002143   3rd Qu.:2.144e-04   3rd Qu.:1.628e-03
##  Max.   :0.0003579   Max.   :2.541e-04   Max.   :2.510e-03
##       C580                C582                C583
##  Min.   :0.000e+00   Min.   :0.001001   Min.   :0.0000000
##  1st Qu.:0.000e+00   1st Qu.:0.002128   1st Qu.:0.0005606
##  Median :3.663e-05   Median :0.002584   Median :0.0008431
##  Mean   :7.385e-05   Mean   :0.002583   Mean   :0.0008351
##  3rd Qu.:1.348e-04   3rd Qu.:0.003131   3rd Qu.:0.0010012
##  Max.   :2.699e-04   Max.   :0.003917   Max.   :0.0022144
##       C584                C586                C587
##  Min.   :0.000000   Min.   :0.000e+00   Min.   :0.0001375
##  1st Qu.:0.001962   1st Qu.:0.000e+00   1st Qu.:0.0003145
##  Median :0.003368   Median :0.000e+00   Median :0.0003853
##  Mean   :0.003068   Mean   :9.289e-06   Mean   :0.0003746
##  3rd Qu.:0.004070   3rd Qu.:0.000e+00   3rd Qu.:0.0004439
##  Max.   :0.006007   Max.   :9.289e-05   Max.   :0.0005714
##       C588                C589                C590
##  Min.   :0.0001246   Min.   :0.0007788   Min.   :0.0000000
##  1st Qu.:0.0005998   1st Qu.:0.0012176   1st Qu.:0.0008237
##  Median :0.0008487   Median :0.0016482   Median :0.0031378
##  Mean   :0.0007675   Mean   :0.0017681   Mean   :0.0027637
##  3rd Qu.:0.0009717   3rd Qu.:0.0022207   3rd Qu.:0.0042393
##  Max.   :0.0011775   Max.   :0.0029508   Max.   :0.0060612
##       C591                C592                C593
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.000e+00
##  1st Qu.:0.0003518   1st Qu.:0.0000000   1st Qu.:0.000e+00
##  Median :0.0005140   Median :0.0001121   Median :0.000e+00
##  Mean   :0.0005836   Mean   :0.0003804   Mean   :5.984e-05
##  3rd Qu.:0.0008492   3rd Qu.:0.0006997   3rd Qu.:5.971e-05
##  Max.   :0.0012806   Max.   :0.0013749   Max.   :3.627e-04
##       C595                C596                C597
##  Min.   :0.0005436   Min.   :0.001350   Min.   :0.0000000
##  1st Qu.:0.0015999   1st Qu.:0.001596   1st Qu.:0.0008843
##  Median :0.0022694   Median :0.001717   Median :0.0010167
##  Mean   :0.0023710   Mean   :0.001805   Mean   :0.0011252
##  3rd Qu.:0.0032403   3rd Qu.:0.002033   3rd Qu.:0.0011765
##  Max.   :0.0042207   Max.   :0.002401   Max.   :0.0030778
##       C598                C599                C600
##  Min.   :5.283e-05   Min.   :0.0004267   Min.   :0.0000000
##  1st Qu.:6.120e-05   1st Qu.:0.0013110   1st Qu.:0.0000000
##  Median :7.264e-05   Median :0.0018149   Median :0.0001123
##  Mean   :7.223e-05   Mean   :0.0019532   Mean   :0.0001882
##  3rd Qu.:8.441e-05   3rd Qu.:0.0024578   3rd Qu.:0.0002495
##  Max.   :9.061e-05   Max.   :0.0037068   Max.   :0.0006871
##       C601                C602                C603
##  Min.   :0.0009163   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0015019   1st Qu.:0.0009356   1st Qu.:0.0000174
##  Median :0.0017332   Median :0.0014632   Median :0.0002781
##  Mean   :0.0018895   Mean   :0.0015814   Mean   :0.0003580
##  3rd Qu.:0.0022080   3rd Qu.:0.0023456   3rd Qu.:0.0006733
##  Max.   :0.0035689   Max.   :0.0035600   Max.   :0.0008550
##       C604                C605                C606
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.0004676   1st Qu.:0.000e+00   1st Qu.:0.000e+00
```

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##  Median :0.0006541   Median :0.000e+00   Median :6.597e-05
##  Mean   :0.0006951   Mean   :7.824e-06   Mean   :7.442e-05
##  3rd Qu.:0.0010206   3rd Qu.:0.000e+00   3rd Qu.:1.308e-04
##  Max.   :0.0013431   Max.   :7.824e-05   Max.   :2.034e-04
##       C608                C609                C610
##  Min.   :0.0002435   Min.   :0.0000000   Min.   :0.0004706
##  1st Qu.:0.0003778   1st Qu.:0.0008393   1st Qu.:0.0005861
##  Median :0.0007403   Median :0.0013469   Median :0.0006805
##  Mean   :0.0007678   Mean   :0.0017605   Mean   :0.0008365
##  3rd Qu.:0.0010820   3rd Qu.:0.0019853   3rd Qu.:0.0008983
##  Max.   :0.0015050   Max.   :0.0062583   Max.   :0.0021530
##       C611                C612                C613
##  Min.   :0.0003704   Min.   :0.0000000   Min.   :0.0002913
##  1st Qu.:0.0005566   1st Qu.:0.0000000   1st Qu.:0.0006744
##  Median :0.0006287   Median :0.0000000   Median :0.0007644
##  Mean   :0.0007511   Mean   :0.0001796   Mean   :0.0007957
##  3rd Qu.:0.0007235   3rd Qu.:0.0000000   3rd Qu.:0.0009487
##  Max.   :0.0018890   Max.   :0.0015839   Max.   :0.0012289
##       C614                C618                C620
##  Min.   :0.0003278   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0004503   1st Qu.:0.0006718   1st Qu.:0.0000000
##  Median :0.0005242   Median :0.0011971   Median :0.0000000
##  Mean   :0.0006022   Mean   :0.0013725   Mean   :0.0001660
##  3rd Qu.:0.0005772   3rd Qu.:0.0018826   3rd Qu.:0.0002893
##  Max.   :0.0015055   Max.   :0.0028833   Max.   :0.0006189
##       C621                C622                C623
##  Min.   :0.0000000   Min.   :0.0002119   Min.   :0.0001944
##  1st Qu.:0.0004616   1st Qu.:0.0002409   1st Qu.:0.0003798
##  Median :0.0007677   Median :0.0002787   Median :0.0010025
##  Mean   :0.0008917   Mean   :0.0002915   Mean   :0.0010892
##  3rd Qu.:0.0015101   3rd Qu.:0.0003358   3rd Qu.:0.0014639
##  Max.   :0.0018110   Max.   :0.0004362   Max.   :0.0030372
##       C624                C625                C626
##  Min.   :0.000e+00   Min.   :8.942e-05   Min.   :0.000e+00
##  1st Qu.:3.669e-05   1st Qu.:2.401e-04   1st Qu.:0.000e+00
##  Median :1.977e-04   Median :4.280e-04   Median :0.000e+00
##  Mean   :1.804e-04   Mean   :3.842e-04   Mean   :2.734e-05
##  3rd Qu.:2.708e-04   3rd Qu.:5.320e-04   3rd Qu.:5.197e-05
##  Max.   :3.992e-04   Max.   :6.009e-04   Max.   :1.073e-04
##       C627                C628                C629
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0000000   1st Qu.:0.0004338   1st Qu.:0.0004200
##  Median :0.0000000   Median :0.0008786   Median :0.0006259
##  Mean   :0.0002173   Mean   :0.0010514   Mean   :0.0010016
##  3rd Qu.:0.0001189   3rd Qu.:0.0016001   3rd Qu.:0.0016675
##  Max.   :0.0017088   Max.   :0.0025046   Max.   :0.0025161
##       C630               C631               C632
##  Min.   :0.001126   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.001970   1st Qu.:0.000e+00   1st Qu.:0.000e+00
##  Median :0.002408   Median :0.000e+00   Median :0.000e+00
##  Mean   :0.002379   Mean   :1.706e-05   Mean   :4.828e-05
##  3rd Qu.:0.002580   3rd Qu.:3.987e-05   3rd Qu.:0.000e+00
##  Max.   :0.003845   Max.   :6.292e-05   Max.   :3.002e-04
##       C633                C634                C638
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##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.0000000
##  1st Qu.:0.0002392   1st Qu.:0.000e+00   1st Qu.:0.0004038
##  Median :0.0006448   Median :0.000e+00   Median :0.0008511
##  Mean   :0.0006844   Mean   :2.316e-05   Mean   :0.0009239
##  3rd Qu.:0.0008319   3rd Qu.:0.000e+00   3rd Qu.:0.0013312
##  Max.   :0.0017289   Max.   :2.316e-04   Max.   :0.0020706
##       C639                C640                C641
##  Min.   :0.0004230   Min.   :0.0005909   Min.   :0.000e+00
##  1st Qu.:0.0008871   1st Qu.:0.0011606   1st Qu.:0.000e+00
##  Median :0.0015638   Median :0.0012798   Median :0.000e+00
##  Mean   :0.0013989   Mean   :0.0014373   Mean   :1.586e-05
##  3rd Qu.:0.0018012   3rd Qu.:0.0016218   3rd Qu.:0.000e+00
##  Max.   :0.0022456   Max.   :0.0027629   Max.   :8.813e-05
##       C644                C645                C646
##  Min.   :0.0001360   Min.   :0.000e+00   Min.   :0.0006056
##  1st Qu.:0.0002282   1st Qu.:0.000e+00   1st Qu.:0.0009732
##  Median :0.0002331   Median :0.000e+00   Median :0.0013585
##  Mean   :0.0002319   Mean   :2.864e-05   Mean   :0.0013879
##  3rd Qu.:0.0002562   3rd Qu.:0.000e+00   3rd Qu.:0.0015678
##  Max.   :0.0002905   Max.   :2.864e-04   Max.   :0.0028489
##       C647                C648                C649
##  Min.   :5.396e-05   Min.   :6.438e-05   Min.   :0.0004612
##  1st Qu.:7.370e-05   1st Qu.:8.596e-04   1st Qu.:0.0008754
##  Median :1.008e-04   Median :1.197e-03   Median :0.0010281
##  Mean   :1.060e-04   Mean   :1.176e-03   Mean   :0.0009769
##  3rd Qu.:1.226e-04   3rd Qu.:1.543e-03   3rd Qu.:0.0011445
##  Max.   :1.740e-04   Max.   :2.337e-03   Max.   :0.0013240
##       C650                C651                C652
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.0003392
##  1st Qu.:0.000e+00   1st Qu.:0.000e+00   1st Qu.:0.0010500
##  Median :0.000e+00   Median :0.000e+00   Median :0.0015406
##  Mean   :2.175e-05   Mean   :2.320e-05   Mean   :0.0014288
##  3rd Qu.:0.000e+00   3rd Qu.:3.807e-05   3rd Qu.:0.0018963
##  Max.   :2.175e-04   Max.   :9.897e-05   Max.   :0.0020997
##       C653                C654                C655
##  Min.   :0.0003446   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0008572   1st Qu.:0.0001475   1st Qu.:0.0001170
##  Median :0.0011880   Median :0.0002714   Median :0.0002229
##  Mean   :0.0011463   Mean   :0.0002609   Mean   :0.0002988
##  3rd Qu.:0.0015078   3rd Qu.:0.0003569   3rd Qu.:0.0005025
##  Max.   :0.0017312   Max.   :0.0005853   Max.   :0.0007471
##       C656                C663               C664
##  Min.   :0.0000000   Min.   :0.000000   Min.   :0.0000000
##  1st Qu.:0.0000000   1st Qu.:0.000730   1st Qu.:0.0000000
##  Median :0.0000000   Median :0.001327   Median :0.0000000
##  Mean   :0.0001099   Mean   :0.001598   Mean   :0.0002455
##  3rd Qu.:0.0001438   3rd Qu.:0.002559   3rd Qu.:0.0002583
##  Max.   :0.0007004   Max.   :0.003841   Max.   :0.0011924
##       C665                C666                C667
##  Min.   :0.0000000   Min.   :0.0004767   Min.   :0.000000
##  1st Qu.:0.0006311   1st Qu.:0.0014731   1st Qu.:0.000304
##  Median :0.0014072   Median :0.0027053   Median :0.001273
##  Mean   :0.0013227   Mean   :0.0023097   Mean   :0.001137
##  3rd Qu.:0.0018448   3rd Qu.:0.0031264   3rd Qu.:0.001900
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##  Max.   :0.0026161   Max.   :0.0034670   Max.   :0.002218
##       C668                C669                C670
##  Min.   :0.000e+00   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:7.452e-05   1st Qu.:0.0000000   1st Qu.:0.0000000
##  Median :5.170e-04   Median :0.0000000   Median :0.0002718
##  Mean   :6.548e-04   Mean   :0.0001193   Mean   :0.0004047
##  3rd Qu.:7.347e-04   3rd Qu.:0.0000000   3rd Qu.:0.0006177
##  Max.   :2.426e-03   Max.   :0.0006642   Max.   :0.0014479
##       C671                C672                C673
##  Min.   :0.000e+00   Min.   :0.001268   Min.   :0.001725
##  1st Qu.:0.000e+00   1st Qu.:0.001856   1st Qu.:0.002336
##  Median :0.000e+00   Median :0.002382   Median :0.003188
##  Mean   :1.615e-05   Mean   :0.002375   Mean   :0.003123
##  3rd Qu.:0.000e+00   3rd Qu.:0.002706   3rd Qu.:0.003729
##  Max.   :1.615e-04   Max.   :0.003777   Max.   :0.004725
##       C674                C677                C678
##  Min.   :0.0000000   Min.   :0.0009087   Min.   :0.000e+00
##  1st Qu.:0.0000000   1st Qu.:0.0012486   1st Qu.:0.000e+00
##  Median :0.0000000   Median :0.0013019   Median :0.000e+00
##  Mean   :0.0001724   Mean   :0.0013433   Mean   :4.665e-05
##  3rd Qu.:0.0002194   3rd Qu.:0.0015250   3rd Qu.:7.651e-05
##  Max.   :0.0009136   Max.   :0.0017495   Max.   :2.167e-04
##       C679                C680                C681
##  Min.   :0.0001217   Min.   :0.0000000   Min.   :0.000e+00
##  1st Qu.:0.0002507   1st Qu.:0.0000000   1st Qu.:0.000e+00
##  Median :0.0003136   Median :0.0002430   Median :0.000e+00
##  Mean   :0.0004430   Mean   :0.0004548   Mean   :1.072e-05
##  3rd Qu.:0.0003989   3rd Qu.:0.0006455   3rd Qu.:0.000e+00
##  Max.   :0.0013170   Max.   :0.0018236   Max.   :1.072e-04
##       C682                C684                C685
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.0000000
##  1st Qu.:0.000e+00   1st Qu.:0.000e+00   1st Qu.:0.0000000
##  Median :0.000e+00   Median :0.000e+00   Median :0.0001639
##  Mean   :1.139e-05   Mean   :2.259e-05   Mean   :0.0002369
##  3rd Qu.:0.000e+00   3rd Qu.:0.000e+00   3rd Qu.:0.0004109
##  Max.   :1.139e-04   Max.   :2.259e-04   Max.   :0.0007359
##       C686                C687                C688
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0001458   1st Qu.:0.0000000   1st Qu.:0.0003627
##  Median :0.0003753   Median :0.0000000   Median :0.0004700
##  Mean   :0.0003948   Mean   :0.0003587   Mean   :0.0004726
##  3rd Qu.:0.0006831   3rd Qu.:0.0006355   3rd Qu.:0.0006609
##  Max.   :0.0007883   Max.   :0.0017698   Max.   :0.0008852
##       C689                C690                C691
##  Min.   :0.0000000   Min.   :0.0001201   Min.   :0.0003127
##  1st Qu.:0.0003611   1st Qu.:0.0001550   1st Qu.:0.0004632
##  Median :0.0013692   Median :0.0001864   Median :0.0005225
##  Mean   :0.0010379   Mean   :0.0001763   Mean   :0.0005187
##  3rd Qu.:0.0015128   3rd Qu.:0.0001905   3rd Qu.:0.0005454
##  Max.   :0.0018785   Max.   :0.0002338   Max.   :0.0007281
##       C692                C693                C694
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:6.872e-05   1st Qu.:0.000e+00   1st Qu.:0.000e+00
##  Median :1.025e-04   Median :0.000e+00   Median :0.000e+00
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##  Mean   :1.101e-04   Mean   :2.540e-05   Mean   :2.633e-05
##  3rd Qu.:1.483e-04   3rd Qu.:5.093e-05   3rd Qu.:0.000e+00
##  Max.   :2.335e-04   Max.   :8.729e-05   Max.   :2.633e-04
##       C695                C697                C700
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0000000   1st Qu.:0.0000000   1st Qu.:0.0001059
##  Median :0.0000000   Median :0.0000000   Median :0.0005421
##  Mean   :0.0000950   Mean   :0.0001966   Mean   :0.0005786
##  3rd Qu.:0.0001535   3rd Qu.:0.0000000   3rd Qu.:0.0006297
##  Max.   :0.0004509   Max.   :0.0016381   Max.   :0.0015791
##       C701                C702                C704
##  Min.   :0.001442   Min.   :0.0003847   Min.   :0.0000000
##  1st Qu.:0.001755   1st Qu.:0.0008009   1st Qu.:0.0004812
##  Median :0.002046   Median :0.0009353   Median :0.0009514
##  Mean   :0.002167   Mean   :0.0009265   Mean   :0.0009455
##  3rd Qu.:0.002464   3rd Qu.:0.0011227   3rd Qu.:0.0012834
##  Max.   :0.003122   Max.   :0.0014933   Max.   :0.0021297
##       C705                C706                C708
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.000e+00   1st Qu.:0.000e+00   1st Qu.:0.000e+00
##  Median :3.738e-05   Median :0.000e+00   Median :0.000e+00
##  Mean   :3.873e-04   Mean   :9.481e-05   Mean   :2.372e-05
##  3rd Qu.:1.566e-04   3rd Qu.:0.000e+00   3rd Qu.:0.000e+00
##  Max.   :2.399e-03   Max.   :9.481e-04   Max.   :1.369e-04
##       C709                C710                C711
##  Min.   :0.0000000   Min.   :0.0006208   Min.   :0.002773
##  1st Qu.:0.0001654   1st Qu.:0.0009822   1st Qu.:0.002964
##  Median :0.0014218   Median :0.0014096   Median :0.004161
##  Mean   :0.0011843   Mean   :0.0015701   Mean   :0.004082
##  3rd Qu.:0.0019786   3rd Qu.:0.0017944   3rd Qu.:0.004632
##  Max.   :0.0023890   Max.   :0.0035091   Max.   :0.006041
##       C712                C714                C716
##  Min.   :0.0004204   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.0010733   1st Qu.:0.000e+00   1st Qu.:0.000e+00
##  Median :0.0014070   Median :0.000e+00   Median :0.000e+00
##  Mean   :0.0013124   Mean   :5.043e-05   Mean   :5.222e-06
##  3rd Qu.:0.0015884   3rd Qu.:7.159e-05   3rd Qu.:0.000e+00
##  Max.   :0.0018388   Max.   :2.547e-04   Max.   :5.222e-05
##       C717                C718                C720
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.0005928
##  1st Qu.:0.000e+00   1st Qu.:0.000e+00   1st Qu.:0.0010513
##  Median :0.000e+00   Median :0.000e+00   Median :0.0014886
##  Mean   :1.095e-05   Mean   :2.897e-05   Mean   :0.0014429
##  3rd Qu.:0.000e+00   3rd Qu.:6.522e-05   3rd Qu.:0.0019624
##  Max.   :1.095e-04   Max.   :1.102e-04   Max.   :0.0021490
##       C721                C722                C723
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:7.578e-05   1st Qu.:5.988e-05   1st Qu.:0.000e+00
##  Median :1.563e-04   Median :8.606e-05   Median :6.622e-05
##  Mean   :1.849e-04   Mean   :1.228e-04   Mean   :5.227e-05
##  3rd Qu.:2.639e-04   3rd Qu.:2.027e-04   3rd Qu.:8.457e-05
##  Max.   :5.531e-04   Max.   :3.442e-04   Max.   :1.143e-04
##       C724                C725                C726
##  Min.   :0.0004527   Min.   :0.0000000   Min.   :0.0000000
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##  1st Qu.:0.0010494   1st Qu.:0.0000000   1st Qu.:0.0000000
##  Median :0.0013662   Median :0.0000000   Median :0.0002456
##  Mean   :0.0012633   Mean   :0.0001883   Mean   :0.0004891
##  3rd Qu.:0.0014228   3rd Qu.:0.0001657   3rd Qu.:0.0006475
##  Max.   :0.0017986   Max.   :0.0009824   Max.   :0.0018191
##       C727                C728                C729
##  Min.   :0.0000000   Min.   :0.0001508   Min.   :0.0008313
##  1st Qu.:0.0000000   1st Qu.:0.0006907   1st Qu.:0.0013544
##  Median :0.0000000   Median :0.0009524   Median :0.0016855
##  Mean   :0.0001153   Mean   :0.0014983   Mean   :0.0017386
##  3rd Qu.:0.0001935   3rd Qu.:0.0023821   3rd Qu.:0.0018956
##  Max.   :0.0005642   Max.   :0.0034216   Max.   :0.0031154
##       C730                C731                C732
##  Min.   :0.0000000   Min.   :0.001806    Min.   :0.0003063
##  1st Qu.:0.0000000   1st Qu.:0.002624    1st Qu.:0.0006937
##  Median :0.0004667   Median :0.003787    Median :0.0014658
##  Mean   :0.0006752   Mean   :0.003725    Mean   :0.0013194
##  3rd Qu.:0.0013733   3rd Qu.:0.004887    3rd Qu.:0.0018417
##  Max.   :0.0017598   Max.   :0.005564    Max.   :0.0022617
##       C733                C734                C735
##  Min.   :0.003632    Min.   :0.0001994   Min.   :0.001084
##  1st Qu.:0.004775    1st Qu.:0.0002872   1st Qu.:0.001762
##  Median :0.004944    Median :0.0004073   Median :0.002136
##  Mean   :0.005281    Mean   :0.0004386   Mean   :0.002015
##  3rd Qu.:0.006088    3rd Qu.:0.0005420   3rd Qu.:0.002267
##  Max.   :0.006684    Max.   :0.0008040   Max.   :0.002723
##       C737                C742                C743
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.0006467
##  1st Qu.:0.0004998   1st Qu.:0.000e+00   1st Qu.:0.0019751
##  Median :0.0021222   Median :6.477e-05   Median :0.0023612
##  Mean   :0.0023997   Mean   :8.359e-05   Mean   :0.0023518
##  3rd Qu.:0.0037495   3rd Qu.:1.195e-04   3rd Qu.:0.0027143
##  Max.   :0.0073219   Max.   :3.280e-04   Max.   :0.0038128
##       C744                C745                C746
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.0000000
##  1st Qu.:0.0001711   1st Qu.:0.000e+00   1st Qu.:0.0003865
##  Median :0.0003101   Median :0.000e+00   Median :0.0006701
##  Mean   :0.0003244   Mean   :3.707e-05   Mean   :0.0006954
##  3rd Qu.:0.0004854   3rd Qu.:0.000e+00   3rd Qu.:0.0008130
##  Max.   :0.0006013   Max.   :1.870e-04   Max.   :0.0022507
##       C747                C748                C749
##  Min.   :0.001760    Min.   :5.480e-05   Min.   :0.000649
##  1st Qu.:0.003631    1st Qu.:6.163e-05   1st Qu.:0.002832
##  Median :0.005148    Median :7.471e-05   Median :0.004178
##  Mean   :0.004922    Mean   :8.218e-05   Mean   :0.003993
##  3rd Qu.:0.005932    3rd Qu.:1.044e-04   3rd Qu.:0.004741
##  Max.   :0.007769    Max.   :1.243e-04   Max.   :0.007371
##       C750                C751                C752
##  Min.   :0.0000000   Min.   :0.0001743   Min.   :0.0005994
##  1st Qu.:0.0002546   1st Qu.:0.0004393   1st Qu.:0.0015569
##  Median :0.0003939   Median :0.0005810   Median :0.0020411
##  Mean   :0.0003835   Mean   :0.0006443   Mean   :0.0018786
##  3rd Qu.:0.0004733   3rd Qu.:0.0008080   3rd Qu.:0.0022939
##  Max.   :0.0008408   Max.   :0.0012218   Max.   :0.0025837
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##       C753               C755               C756
##  Min.   :0.000919   Min.   :0.0000000   Min.   :0.000e+00
##  1st Qu.:0.001627   1st Qu.:0.0000000   1st Qu.:0.000e+00
##  Median :0.002043   Median :0.0000000   Median :4.847e-05
##  Mean   :0.002319   Mean   :0.0005168   Mean   :7.683e-05
##  3rd Qu.:0.003050   3rd Qu.:0.0008637   3rd Qu.:1.253e-04
##  Max.   :0.004002   Max.   :0.0025505   Max.   :2.385e-04
##       C757               C760               C761
##  Min.   :0.00e+00   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.00e+00   1st Qu.:0.000e+00   1st Qu.:0.000e+00
##  Median :0.00e+00   Median :0.000e+00   Median :0.000e+00
##  Mean   :7.77e-06   Mean   :6.454e-05   Mean   :6.222e-05
##  3rd Qu.:0.00e+00   3rd Qu.:1.514e-04   3rd Qu.:7.495e-05
##  Max.   :7.77e-05   Max.   :2.027e-04   Max.   :2.622e-04
##       C762               C763               C764
##  Min.   :0.0008758   Min.   :0.0005945   Min.   :0.0006571
##  1st Qu.:0.0012132   1st Qu.:0.0011436   1st Qu.:0.0008827
##  Median :0.0017223   Median :0.0015925   Median :0.0012062
##  Mean   :0.0015828   Mean   :0.0017394   Mean   :0.0013722
##  3rd Qu.:0.0019247   3rd Qu.:0.0023497   3rd Qu.:0.0013376
##  Max.   :0.0022181   Max.   :0.0029231   Max.   :0.0031712
##       C765               C766               C767
##  Min.   :0.0000000   Min.   :0.0004497   Min.   :0.000e+00
##  1st Qu.:0.0000000   1st Qu.:0.0010980   1st Qu.:0.000e+00
##  Median :0.0003050   Median :0.0013768   Median :0.000e+00
##  Mean   :0.0004201   Mean   :0.0015095   Mean   :1.961e-05
##  3rd Qu.:0.0006666   3rd Qu.:0.0020768   3rd Qu.:0.000e+00
##  Max.   :0.0015867   Max.   :0.0024338   Max.   :1.064e-04
##       C768               C771               C772
##  Min.   :0.000e+00   Min.   :8.688e-05   Min.   :0.000e+00
##  1st Qu.:0.000e+00   1st Qu.:1.609e-04   1st Qu.:5.041e-05
##  Median :0.000e+00   Median :1.951e-04   Median :5.962e-05
##  Mean   :9.987e-06   Mean   :2.169e-04   Mean   :7.759e-05
##  3rd Qu.:0.000e+00   3rd Qu.:2.738e-04   3rd Qu.:8.845e-05
##  Max.   :9.987e-05   Max.   :3.798e-04   Max.   :2.015e-04
##       C774               C775               C776
##  Min.   :0.0000000   Min.   :0.0003561   Min.   :0.0000000
##  1st Qu.:0.0000000   1st Qu.:0.0004697   1st Qu.:0.0001095
##  Median :0.0001209   Median :0.0006837   Median :0.0009297
##  Mean   :0.0002388   Mean   :0.0006910   Mean   :0.0011882
##  3rd Qu.:0.0002043   3rd Qu.:0.0008728   3rd Qu.:0.0015822
##  Max.   :0.0009317   Max.   :0.0011443   Max.   :0.0039737
##       C777               C778               C779
##  Min.   :9.107e-05   Min.   :0.0008308   Min.   :0.0005031
##  1st Qu.:2.555e-04   1st Qu.:0.0015700   1st Qu.:0.0008285
##  Median :2.734e-04   Median :0.0018316   Median :0.0014701
##  Mean   :3.772e-04   Mean   :0.0018509   Mean   :0.0013563
##  3rd Qu.:4.801e-04   3rd Qu.:0.0020749   3rd Qu.:0.0016425
##  Max.   :8.497e-04   Max.   :0.0029662   Max.   :0.0021995
##       C780               C781               C782
##  Min.   :0.0001439   Min.   :0.000e+00   Min.   :0.0000000
##  1st Qu.:0.0010781   1st Qu.:0.000e+00   1st Qu.:0.0002261
##  Median :0.0015728   Median :0.000e+00   Median :0.0014616
##  Mean   :0.0015052   Mean   :5.703e-05   Mean   :0.0016241
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##  3rd Qu.:0.0019583   3rd Qu.:0.000e+00   3rd Qu.:0.0028604
##  Max.   :0.0027981   Max.   :5.703e-04   Max.   :0.0037940
##       C786                C787                C788
##  Min.   :0.0000000   Min.   :0.0001145   Min.   :0.0006920
##  1st Qu.:0.0001323   1st Qu.:0.0001844   1st Qu.:0.0008434
##  Median :0.0008908   Median :0.0002068   Median :0.0013602
##  Mean   :0.0008673   Mean   :0.0002055   Mean   :0.0014193
##  3rd Qu.:0.0010708   3rd Qu.:0.0002403   3rd Qu.:0.0018405
##  Max.   :0.0022591   Max.   :0.0002763   Max.   :0.0024527
##       C789                C790               C791
##  Min.   :0.000e+00   Min.   :0.002846   Min.   :0.0000911
##  1st Qu.:1.315e-05   1st Qu.:0.003329   1st Qu.:0.0001844
##  Median :2.745e-04   Median :0.004253   Median :0.0002511
##  Mean   :3.263e-04   Mean   :0.004237   Mean   :0.0002521
##  3rd Qu.:5.296e-04   3rd Qu.:0.004799   3rd Qu.:0.0003168
##  Max.   :1.022e-03   Max.   :0.006823   Max.   :0.0004077
##       C792                C793               C794
##  Min.   :0.0000000   Min.   :0.002395   Min.   :0.0007528
##  1st Qu.:0.0002549   1st Qu.:0.003465   1st Qu.:0.0022069
##  Median :0.0003908   Median :0.004280   Median :0.0026243
##  Mean   :0.0003702   Mean   :0.003963   Mean   :0.0025241
##  3rd Qu.:0.0004859   3rd Qu.:0.004480   3rd Qu.:0.0029794
##  Max.   :0.0007198   Max.   :0.005134   Max.   :0.0040810
##       C795                C796                C797
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0003395
##  1st Qu.:0.0001338   1st Qu.:0.0000000   1st Qu.:0.0006723
##  Median :0.0002868   Median :0.0003900   Median :0.0008675
##  Mean   :0.0003134   Mean   :0.0005193   Mean   :0.0008601
##  3rd Qu.:0.0003725   3rd Qu.:0.0009603   3rd Qu.:0.0010732
##  Max.   :0.0008866   Max.   :0.0014182   Max.   :0.0013384
##       C798                C799                C800
##  Min.   :0.0002878   Min.   :0.0006842   Min.   :0.000e+00
##  1st Qu.:0.0004590   1st Qu.:0.0008754   1st Qu.:0.000e+00
##  Median :0.0005023   Median :0.0010165   Median :0.000e+00
##  Mean   :0.0005869   Mean   :0.0013195   Mean   :6.434e-05
##  3rd Qu.:0.0007083   3rd Qu.:0.0015766   3rd Qu.:1.549e-04
##  Max.   :0.0009928   Max.   :0.0024877   Max.   :1.906e-04
##       C801                C802                C803
##  Min.   :7.186e-05   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:7.939e-04   1st Qu.:0.0000000   1st Qu.:0.0004122
##  Median :1.010e-03   Median :0.0005459   Median :0.0009187
##  Mean   :1.066e-03   Mean   :0.0006201   Mean   :0.0009072
##  3rd Qu.:1.469e-03   3rd Qu.:0.0009589   3rd Qu.:0.0013134
##  Max.   :1.775e-03   Max.   :0.0020693   Max.   :0.0018136
##       C804                C805                C806
##  Min.   :0.0002579   Min.   :0.0002219   Min.   :0.000e+00
##  1st Qu.:0.0002800   1st Qu.:0.0003386   1st Qu.:0.000e+00
##  Median :0.0003429   Median :0.0003729   Median :0.000e+00
##  Mean   :0.0003949   Mean   :0.0004198   Mean   :2.357e-05
##  3rd Qu.:0.0005060   3rd Qu.:0.0005016   3rd Qu.:4.691e-05
##  Max.   :0.0006811   Max.   :0.0007332   Max.   :7.495e-05
##       C807                C809                C810
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.0001542   1st Qu.:0.000e+00   1st Qu.:0.000e+00
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##  Median :0.0004011   Median :0.000e+00   Median :0.000e+00
##  Mean   :0.0004919   Mean   :1.793e-05   Mean   :3.523e-05
##  3rd Qu.:0.0009150   3rd Qu.:0.000e+00   3rd Qu.:6.201e-05
##  Max.   :0.0009807   Max.   :1.148e-04   Max.   :1.678e-04
##       C812                C813                C814
##  Min.   :0.000e+00   Min.   :0.0005016   Min.   :0.0006304
##  1st Qu.:0.000e+00   1st Qu.:0.0008329   1st Qu.:0.0007184
##  Median :0.000e+00   Median :0.0009885   Median :0.0008206
##  Mean   :6.752e-05   Mean   :0.0010199   Mean   :0.0009239
##  3rd Qu.:1.455e-04   3rd Qu.:0.0012448   3rd Qu.:0.0010473
##  Max.   :2.206e-04   Max.   :0.0014469   Max.   :0.0015460
##       C815                C816                C817
##  Min.   :0.0001317   Min.   :0.0004253   Min.   :0.0000000
##  1st Qu.:0.0002972   1st Qu.:0.0006197   1st Qu.:0.0000520
##  Median :0.0009624   Median :0.0012712   Median :0.0005041
##  Mean   :0.0009305   Mean   :0.0014094   Mean   :0.0009269
##  3rd Qu.:0.0015329   3rd Qu.:0.0018317   3rd Qu.:0.0009567
##  Max.   :0.0017088   Max.   :0.0033397   Max.   :0.0035471
##       C818               C819               C820
##  Min.   :0.000000   Min.   :0.0007773   Min.   :0.001908
##  1st Qu.:0.002736   1st Qu.:0.0010837   1st Qu.:0.002194
##  Median :0.003208   Median :0.0013032   Median :0.002548
##  Mean   :0.003191   Mean   :0.0014365   Mean   :0.002657
##  3rd Qu.:0.003780   3rd Qu.:0.0019354   3rd Qu.:0.003032
##  Max.   :0.005134   Max.   :0.0021714   Max.   :0.003825
##       C821                C822                C823
##  Min.   :0.000e+00   Min.   :0.0002546   Min.   :0.0008873
##  1st Qu.:0.000e+00   1st Qu.:0.0012160   1st Qu.:0.0010022
##  Median :0.000e+00   Median :0.0013216   Median :0.0010797
##  Mean   :2.621e-05   Mean   :0.0013796   Mean   :0.0010969
##  3rd Qu.:0.000e+00   3rd Qu.:0.0016699   3rd Qu.:0.0011994
##  Max.   :2.100e-04   Max.   :0.0021265   Max.   :0.0013517
##       C824                C825                C826
##  Min.   :0.0001036   Min.   :0.0001207   Min.   :0.000e+00
##  1st Qu.:0.0001138   1st Qu.:0.0001636   1st Qu.:0.000e+00
##  Median :0.0001267   Median :0.0002034   Median :0.000e+00
##  Mean   :0.0001400   Mean   :0.0002144   Mean   :2.339e-05
##  3rd Qu.:0.0001474   3rd Qu.:0.0002471   3rd Qu.:0.000e+00
##  Max.   :0.0002099   Max.   :0.0003572   Max.   :2.339e-04
##       C827                C828                C829
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.0e+00
##  1st Qu.:0.0002591   1st Qu.:0.000e+00   1st Qu.:0.0e+00
##  Median :0.0003480   Median :5.710e-05   Median :0.0e+00
##  Mean   :0.0003601   Mean   :8.764e-05   Mean   :8.4e-06
##  3rd Qu.:0.0004407   3rd Qu.:1.755e-04   3rd Qu.:0.0e+00
##  Max.   :0.0007792   Max.   :2.204e-04   Max.   :8.4e-05
##       C831                C832                C833
##  Min.   :0.000e+00   Min.   :0.0005889   Min.   :0.0007868
##  1st Qu.:0.000e+00   1st Qu.:0.0007188   1st Qu.:0.0009130
##  Median :0.000e+00   Median :0.0008331   Median :0.0010070
##  Mean   :8.876e-05   Mean   :0.0008665   Mean   :0.0010242
##  3rd Qu.:0.000e+00   3rd Qu.:0.0009523   3rd Qu.:0.0010478
##  Max.   :6.495e-04   Max.   :0.0012994   Max.   :0.0013951
##       C835                C840                C841
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##  Min.   :0.0002231   Min.   :0.0003981   Min.   :0.0003462
##  1st Qu.:0.0004869   1st Qu.:0.0007147   1st Qu.:0.0004809
##  Median :0.0006470   Median :0.0010874   Median :0.0005559
##  Mean   :0.0006216   Mean   :0.0009690   Mean   :0.0005996
##  3rd Qu.:0.0007714   3rd Qu.:0.0012070   3rd Qu.:0.0007210
##  Max.   :0.0010212   Max.   :0.0014189   Max.   :0.0009303
##       C842                C843                C844
##  Min.   :0.0004503   Min.   :5.668e-05   Min.   :0.000e+00
##  1st Qu.:0.0006046   1st Qu.:1.331e-04   1st Qu.:0.000e+00
##  Median :0.0007731   Median :3.145e-04   Median :0.000e+00
##  Mean   :0.0007299   Mean   :3.186e-04   Mean   :7.548e-05
##  3rd Qu.:0.0008053   3rd Qu.:4.971e-04   3rd Qu.:0.000e+00
##  Max.   :0.0009879   Max.   :6.263e-04   Max.   :6.627e-04
##       C846                C848                C849
##  Min.   :0.000e+00   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.000e+00   1st Qu.:0.0000000   1st Qu.:0.0001927
##  Median :0.000e+00   Median :0.0002411   Median :0.0002756
##  Mean   :1.275e-05   Mean   :0.0002685   Mean   :0.0002791
##  3rd Qu.:0.000e+00   3rd Qu.:0.0003990   3rd Qu.:0.0004104
##  Max.   :7.346e-05   Max.   :0.0008935   Max.   :0.0004452
##       C850                C851                C853
##  Min.   :0.000e+00   Min.   :5.868e-05   Min.   :0.000e+00
##  1st Qu.:0.000e+00   1st Qu.:7.995e-05   1st Qu.:0.000e+00
##  Median :0.000e+00   Median :8.413e-05   Median :0.000e+00
##  Mean   :4.040e-05   Mean   :8.796e-05   Mean   :1.260e-05
##  3rd Qu.:5.011e-05   3rd Qu.:9.765e-05   3rd Qu.:0.000e+00
##  Max.   :2.171e-04   Max.   :1.205e-04   Max.   :6.634e-05
##       C856                C857                C858
##  Min.   :0.0003880   Min.   :0.0002621   Min.   :0.0001509
##  1st Qu.:0.0004661   1st Qu.:0.0004501   1st Qu.:0.0004376
##  Median :0.0005859   Median :0.0005088   Median :0.0005445
##  Mean   :0.0005444   Mean   :0.0005835   Mean   :0.0006040
##  3rd Qu.:0.0006069   3rd Qu.:0.0005602   3rd Qu.:0.0008848
##  Max.   :0.0006465   Max.   :0.0014523   Max.   :0.0010006
##       C859                C860               C861
##  Min.   :0.000e+00   Min.   :0.00e+00   Min.   :0.000e+00
##  1st Qu.:0.000e+00   1st Qu.:0.00e+00   1st Qu.:0.000e+00
##  Median :0.000e+00   Median :0.00e+00   Median :6.647e-05
##  Mean   :4.923e-05   Mean   :1.16e-05   Mean   :9.709e-05
##  3rd Qu.:0.000e+00   3rd Qu.:0.00e+00   3rd Qu.:1.300e-04
##  Max.   :3.176e-04   Max.   :1.16e-04   Max.   :3.442e-04
##       C862               C864                C866
##  Min.   :0.00e+00   Min.   :0.0004662   Min.   :0.000e+00
##  1st Qu.:0.00e+00   1st Qu.:0.0005307   1st Qu.:0.000e+00
##  Median :0.00e+00   Median :0.0006591   Median :4.291e-05
##  Mean   :9.04e-06   Mean   :0.0006422   Mean   :2.160e-04
##  3rd Qu.:0.00e+00   3rd Qu.:0.0007168   3rd Qu.:3.850e-04
##  Max.   :9.04e-05   Max.   :0.0008807   Max.   :8.790e-04
##       C867                C868                C870
##  Min.   :0.0000000   Min.   :0.0003074   Min.   :0.000e+00
##  1st Qu.:0.0001507   1st Qu.:0.0004221   1st Qu.:0.000e+00
##  Median :0.0003423   Median :0.0004884   Median :0.000e+00
##  Mean   :0.0005599   Mean   :0.0005071   Mean   :5.710e-05
##  3rd Qu.:0.0009662   3rd Qu.:0.0006166   3rd Qu.:4.763e-05
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##  Max.   :0.0015535   Max.   :0.0007088   Max.   :3.609e-04
##       C871                C874                C878
##  Min.   :0.000e+00   Min.   :0.0000000   Min.   :0.000e+00
##  1st Qu.:3.005e-05   1st Qu.:0.0000000   1st Qu.:0.000e+00
##  Median :3.725e-04   Median :0.0000000   Median :5.704e-05
##  Mean   :4.214e-04   Mean   :0.0001016   Mean   :5.715e-05
##  3rd Qu.:6.069e-04   3rd Qu.:0.0000000   3rd Qu.:9.239e-05
##  Max.   :1.161e-03   Max.   :0.0010160   Max.   :1.802e-04
##       C882                C885                C886
##  Min.   :0.000e+00   Min.   :0.0001850   Min.   :0.000e+00
##  1st Qu.:5.137e-05   1st Qu.:0.0002454   1st Qu.:0.000e+00
##  Median :5.959e-05   Median :0.0004039   Median :0.000e+00
##  Mean   :5.463e-05   Mean   :0.0005527   Mean   :7.001e-05
##  3rd Qu.:7.635e-05   3rd Qu.:0.0008393   3rd Qu.:0.000e+00
##  Max.   :8.865e-05   Max.   :0.0013136   Max.   :7.001e-04
##       C887                C889                C890
##  Min.   :0.0006338   Min.   :0.000e+00   Min.   :0.0001725
##  1st Qu.:0.0007992   1st Qu.:0.000e+00   1st Qu.:0.0002678
##  Median :0.0010932   Median :0.000e+00   Median :0.0003626
##  Mean   :0.0010780   Mean   :6.306e-05   Mean   :0.0003367
##  3rd Qu.:0.0012222   3rd Qu.:0.000e+00   3rd Qu.:0.0003962
##  Max.   :0.0015988   Max.   :3.634e-04   Max.   :0.0004686
##       C891               C892               C894
##  Min.   :0.001093   Min.   :0.0001021   Min.   :0.000e+00
##  1st Qu.:0.001191   1st Qu.:0.0003134   1st Qu.:9.958e-05
##  Median :0.001488   Median :0.0003987   Median :1.282e-04
##  Mean   :0.001585   Mean   :0.0005563   Mean   :1.508e-04
##  3rd Qu.:0.001823   3rd Qu.:0.0007977   3rd Qu.:2.082e-04
##  Max.   :0.002537   Max.   :0.0015440   Max.   :2.906e-04
##       C895                C896                C898
##  Min.   :0.000e+00   Min.   :0.0005360   Min.   :4.213e-05
##  1st Qu.:3.319e-05   1st Qu.:0.0007752   1st Qu.:6.178e-05
##  Median :2.664e-04   Median :0.0010141   Median :7.363e-05
##  Mean   :4.238e-04   Mean   :0.0010531   Mean   :7.550e-05
##  3rd Qu.:5.808e-04   3rd Qu.:0.0013157   3rd Qu.:8.748e-05
##  Max.   :1.609e-03   Max.   :0.0016528   Max.   :1.062e-04
##       C899                C900                C901
##  Min.   :0.0001036   Min.   :0.0000000   Min.   :0.000e+00
##  1st Qu.:0.0002575   1st Qu.:0.0000000   1st Qu.:0.000e+00
##  Median :0.0002921   Median :0.0001844   Median :0.000e+00
##  Mean   :0.0003030   Mean   :0.0002812   Mean   :2.039e-05
##  3rd Qu.:0.0003423   3rd Qu.:0.0003767   3rd Qu.:0.000e+00
##  Max.   :0.0005114   Max.   :0.0009687   Max.   :2.039e-04
##       C903                C904                C907
##  Min.   :0.0000000   Min.   :0.0002889   Min.   :0.000e+00
##  1st Qu.:0.0000000   1st Qu.:0.0003593   1st Qu.:0.000e+00
##  Median :0.0004234   Median :0.0004197   Median :0.000e+00
##  Mean   :0.0005121   Mean   :0.0004141   Mean   :3.829e-05
##  3rd Qu.:0.0009152   3rd Qu.:0.0004646   3rd Qu.:6.992e-05
##  Max.   :0.0013330   Max.   :0.0005219   Max.   :1.601e-04
##       C908                C909                C910
##  Min.   :0.000e+00   Min.   :0.0004125   Min.   :0.0000000
##  1st Qu.:0.000e+00   1st Qu.:0.0008163   1st Qu.:0.0001464
##  Median :0.000e+00   Median :0.0010361   Median :0.0003235
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##  Mean   :3.045e-04   Mean   :0.0010862   Mean   :0.0003303
##  3rd Qu.:7.169e-05   3rd Qu.:0.0012822   3rd Qu.:0.0003795
##  Max.   :2.062e-03   Max.   :0.0019412   Max.   :0.0009012
##       C911                C912                C913
##  Min.   :0.0001589   Min.   :0.0001774   Min.   :0.000e+00
##  1st Qu.:0.0002136   1st Qu.:0.0004241   1st Qu.:0.000e+00
##  Median :0.0003066   Median :0.0005750   Median :0.000e+00
##  Mean   :0.0002988   Mean   :0.0005607   Mean   :1.763e-05
##  3rd Qu.:0.0003716   3rd Qu.:0.0006868   3rd Qu.:0.000e+00
##  Max.   :0.0004588   Max.   :0.0011276   Max.   :1.763e-04
##       C914                C919                C920
##  Min.   :0.0002685   Min.   :0.000e+00   Min.   :0.0003425
##  1st Qu.:0.0007161   1st Qu.:0.000e+00   1st Qu.:0.0004704
##  Median :0.0011870   Median :0.000e+00   Median :0.0004920
##  Mean   :0.0012213   Mean   :1.463e-05   Mean   :0.0004989
##  3rd Qu.:0.0015383   3rd Qu.:0.000e+00   3rd Qu.:0.0005236
##  Max.   :0.0022868   Max.   :9.100e-05   Max.   :0.0006736
##       C921                C922                C923
##  Min.   :0.000e+00   Min.   :0.0001548   Min.   :0.0000000
##  1st Qu.:4.617e-05   1st Qu.:0.0002388   1st Qu.:0.0000000
##  Median :6.560e-04   Median :0.0002435   Median :0.0000000
##  Mean   :5.253e-04   Mean   :0.0004021   Mean   :0.0002314
##  3rd Qu.:7.515e-04   3rd Qu.:0.0005068   3rd Qu.:0.0003906
##  Max.   :1.152e-03   Max.   :0.0011691   Max.   :0.0008641
##       C925                C926                C927
##  Min.   :0.0002871   Min.   :0.0000000   Min.   :9.952e-05
##  1st Qu.:0.0003844   1st Qu.:0.0000000   1st Qu.:1.315e-04
##  Median :0.0007132   Median :0.0000000   Median :1.612e-04
##  Mean   :0.0006828   Mean   :0.0001416   Mean   :1.683e-04
##  3rd Qu.:0.0009126   3rd Qu.:0.0002514   3rd Qu.:1.783e-04
##  Max.   :0.0012914   Max.   :0.0005555   Max.   :2.710e-04
##       C929                C930                C931
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.0001567
##  1st Qu.:0.000e+00   1st Qu.:6.903e-05   1st Qu.:0.0003288
##  Median :5.275e-05   Median :7.284e-05   Median :0.0003813
##  Mean   :3.713e-05   Mean   :7.857e-05   Mean   :0.0005801
##  3rd Qu.:6.364e-05   3rd Qu.:1.039e-04   3rd Qu.:0.0005188
##  Max.   :7.098e-05   Max.   :1.390e-04   Max.   :0.0017529
##       C932                C933                C934
##  Min.   :0.000e+00   Min.   :0.0001319   Min.   :0.000e+00
##  1st Qu.:0.000e+00   1st Qu.:0.0003659   1st Qu.:4.849e-05
##  Median :5.214e-05   Median :0.0005215   Median :4.484e-04
##  Mean   :8.303e-05   Mean   :0.0005752   Mean   :5.156e-04
##  3rd Qu.:1.356e-04   3rd Qu.:0.0006988   3rd Qu.:6.806e-04
##  Max.   :2.913e-04   Max.   :0.0012054   Max.   :1.780e-03
##       C935                C936                C937
##  Min.   :0.0001415   Min.   :0.0004919   Min.   :0.0000000
##  1st Qu.:0.0002205   1st Qu.:0.0007204   1st Qu.:0.0003406
##  Median :0.0002881   Median :0.0008135   Median :0.0005439
##  Mean   :0.0002653   Mean   :0.0007766   Mean   :0.0005733
##  3rd Qu.:0.0003114   3rd Qu.:0.0008833   3rd Qu.:0.0008897
##  Max.   :0.0003373   Max.   :0.0010007   Max.   :0.0013053
##       C938                C939                C940
##  Min.   :0.000e+00   Min.   :9.921e-05   Min.   :0.0000000
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##  1st Qu.:0.000e+00   1st Qu.:1.429e-04   1st Qu.:0.0000000
##  Median :5.317e-05   Median :1.834e-04   Median :0.0000000
##  Mean   :4.098e-05   Mean   :1.919e-04   Mean   :0.0000849
##  3rd Qu.:7.114e-05   3rd Qu.:2.294e-04   3rd Qu.:0.0001162
##  Max.   :8.672e-05   Max.   :3.287e-04   Max.   :0.0003831
##       C941                C942                C943
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:3.437e-05   1st Qu.:0.000e+00   1st Qu.:0.000e+00
##  Median :2.044e-04   Median :0.000e+00   Median :6.473e-05
##  Mean   :6.165e-04   Mean   :4.726e-05   Mean   :1.060e-04
##  3rd Qu.:6.581e-04   3rd Qu.:4.078e-05   3rd Qu.:1.334e-04
##  Max.   :2.974e-03   Max.   :2.151e-04   Max.   :3.995e-04
##       C944                C945                C946
##  Min.   :0.001160   Min.   :0.0009684   Min.   :0.0002579
##  1st Qu.:0.001409   1st Qu.:0.0010738   1st Qu.:0.0005217
##  Median :0.001808   Median :0.0012733   Median :0.0008408
##  Mean   :0.002094   Mean   :0.0013895   Mean   :0.0008860
##  3rd Qu.:0.002915   3rd Qu.:0.0014731   3rd Qu.:0.0012928
##  Max.   :0.003257   Max.   :0.0026154   Max.   :0.0014317
##       C947                C948                C949
##  Min.   :0.0002191   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0003201   1st Qu.:0.0000000   1st Qu.:0.0000000
##  Median :0.0005247   Median :0.0001444   Median :0.0002421
##  Mean   :0.0005216   Mean   :0.0006337   Mean   :0.0004638
##  3rd Qu.:0.0005859   3rd Qu.:0.0010342   3rd Qu.:0.0009638
##  Max.   :0.0010793   Max.   :0.0028130   Max.   :0.0012577
##       C952                C955                C956
##  Min.   :0.0000000   Min.   :0.0001141   Min.   :0.0001799
##  1st Qu.:0.0000000   1st Qu.:0.0002114   1st Qu.:0.0002227
##  Median :0.0000000   Median :0.0002602   Median :0.0002830
##  Mean   :0.0002444   Mean   :0.0002634   Mean   :0.0004656
##  3rd Qu.:0.0003206   3rd Qu.:0.0003175   3rd Qu.:0.0006292
##  Max.   :0.0009459   Max.   :0.0003819   Max.   :0.0012485
##       C957                C959                C960
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.0000000
##  1st Qu.:3.004e-05   1st Qu.:0.000e+00   1st Qu.:0.0002555
##  Median :2.322e-04   Median :0.000e+00   Median :0.0003098
##  Mean   :3.837e-04   Mean   :1.630e-05   Mean   :0.0003157
##  3rd Qu.:4.426e-04   3rd Qu.:0.000e+00   3rd Qu.:0.0003827
##  Max.   :1.348e-03   Max.   :9.799e-05   Max.   :0.0006326
##       C961                C962                C967
##  Min.   :0.0003159   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.0005833   1st Qu.:0.000e+00   1st Qu.:0.000e+00
##  Median :0.0008420   Median :0.000e+00   Median :3.039e-05
##  Mean   :0.0008071   Mean   :4.570e-05   Mean   :5.906e-05
##  3rd Qu.:0.0010227   3rd Qu.:7.912e-05   3rd Qu.:1.180e-04
##  Max.   :0.0011907   Max.   :1.834e-04   Max.   :1.812e-04
##       C968                C970                C971
##  Min.   :0.0000000   Min.   :0.0008595   Min.   :0.0005279
##  1st Qu.:0.0006941   1st Qu.:0.0009883   1st Qu.:0.0011342
##  Median :0.0012607   Median :0.0014584   Median :0.0011964
##  Mean   :0.0012889   Mean   :0.0033103   Mean   :0.0013455
##  3rd Qu.:0.0016856   3rd Qu.:0.0024248   3rd Qu.:0.0015994
##  Max.   :0.0028818   Max.   :0.0172678   Max.   :0.0023718
```

```
##       C972                C973                C974
##  Min.   :0.0000000   Min.   :0.0002439   Min.   :0.000624
##  1st Qu.:0.0000000   1st Qu.:0.0004896   1st Qu.:0.001583
##  Median :0.0000000   Median :0.0009232   Median :0.001903
##  Mean   :0.0002199   Mean   :0.0009414   Mean   :0.001905
##  3rd Qu.:0.0004649   3rd Qu.:0.0012682   3rd Qu.:0.002350
##  Max.   :0.0008062   Max.   :0.0019409   Max.   :0.002922
##       C975                C980                C981
##  Min.   :0.0003466   Min.   :0.0000000   Min.   :0.000e+00
##  1st Qu.:0.0004368   1st Qu.:0.0000000   1st Qu.:5.076e-05
##  Median :0.0007460   Median :0.0006445   Median :2.831e-04
##  Mean   :0.0008137   Mean   :0.0007875   Mean   :2.810e-04
##  3rd Qu.:0.0011603   3rd Qu.:0.0011804   3rd Qu.:4.787e-04
##  Max.   :0.0014487   Max.   :0.0026199   Max.   :5.736e-04
##       C984                C986                C987
##  Min.   :0.0002064   Min.   :0.000e+00   Min.   :0.0006492
##  1st Qu.:0.0002604   1st Qu.:0.000e+00   1st Qu.:0.0007283
##  Median :0.0003401   Median :0.000e+00   Median :0.0008623
##  Mean   :0.0003766   Mean   :4.539e-05   Mean   :0.0009134
##  3rd Qu.:0.0004136   3rd Qu.:9.335e-05   3rd Qu.:0.0009889
##  Max.   :0.0006563   Max.   :1.615e-04   Max.   :0.0015257
##       C988                C989                C990
##  Min.   :0.000e+00   Min.   :0.0004503   Min.   :0.000e+00
##  1st Qu.:0.000e+00   1st Qu.:0.0006437   1st Qu.:0.000e+00
##  Median :0.000e+00   Median :0.0007467   Median :0.000e+00
##  Mean   :2.138e-05   Mean   :0.0007326   Mean   :3.152e-05
##  3rd Qu.:0.000e+00   3rd Qu.:0.0008450   3rd Qu.:5.346e-05
##  Max.   :1.474e-04   Max.   :0.0010185   Max.   :1.611e-04
##       C991                C992                C994
##  Min.   :0.0000000   Min.   :0.0005245   Min.   :0.000e+00
##  1st Qu.:0.0001793   1st Qu.:0.0007193   1st Qu.:1.426e-05
##  Median :0.0002643   Median :0.0007999   Median :8.088e-05
##  Mean   :0.0002821   Mean   :0.0007795   Mean   :1.949e-04
##  3rd Qu.:0.0003627   3rd Qu.:0.0008937   3rd Qu.:3.114e-04
##  Max.   :0.0007103   Max.   :0.0009767   Max.   :6.474e-04
##       C995                C996                C999
##  Min.   :0.0000000   Min.   :0.0005284   Min.   :0.0002109
##  1st Qu.:0.0000000   1st Qu.:0.0005560   1st Qu.:0.0003531
##  Median :0.0000000   Median :0.0006026   Median :0.0004592
##  Mean   :0.0001381   Mean   :0.0006462   Mean   :0.0004612
##  3rd Qu.:0.0000000   3rd Qu.:0.0007051   3rd Qu.:0.0005336
##  Max.   :0.0010254   Max.   :0.0008844   Max.   :0.0007113
##      C1000               C1001               C1002
##  Min.   :0.0000000   Min.   :8.103e-05   Min.   :0.000e+00
##  1st Qu.:0.0000000   1st Qu.:1.792e-04   1st Qu.:0.000e+00
##  Median :0.0000000   Median :2.278e-04   Median :0.000e+00
##  Mean   :0.0001595   Mean   :5.914e-04   Mean   :1.450e-05
##  3rd Qu.:0.0000000   3rd Qu.:5.948e-04   3rd Qu.:0.000e+00
##  Max.   :0.0015954   Max.   :2.776e-03   Max.   :7.512e-05
##      C1003               C1004               C1005
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.000e+00
##  1st Qu.:0.000e+00   1st Qu.:0.000e+00   1st Qu.:0.000e+00
##  Median :0.000e+00   Median :3.056e-05   Median :0.000e+00
##  Mean   :3.642e-05   Mean   :7.192e-05   Mean   :4.011e-05
```

```
##  3rd Qu.:0.000e+00   3rd Qu.:1.211e-04   3rd Qu.:0.000e+00
##  Max.   :3.642e-04   Max.   :2.547e-04   Max.   :4.011e-04
##      C1007               C1008               C1009
##  Min.   :0.0001818   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.0003675   1st Qu.:0.0000000   1st Qu.:0.0000000
##  Median :0.0025029   Median :0.0001973   Median :0.0000000
##  Mean   :0.0027261   Mean   :0.0002795   Mean   :0.0003482
##  3rd Qu.:0.0041291   3rd Qu.:0.0004015   3rd Qu.:0.0003282
##  Max.   :0.0065129   Max.   :0.0009726   Max.   :0.0016513
##      C1010               C1011               C1012
##  Min.   :0.000e+00   Min.   :0.000e+00   Min.   :0.0000000
##  1st Qu.:0.000e+00   1st Qu.:2.936e-05   1st Qu.:0.0001374
##  Median :4.805e-05   Median :3.782e-04   Median :0.0002674
##  Mean   :5.139e-04   Mean   :1.186e-03   Mean   :0.0003418
##  3rd Qu.:2.742e-04   3rd Qu.:1.925e-03   3rd Qu.:0.0005591
##  Max.   :2.650e-03   Max.   :5.450e-03   Max.   :0.0008542
##      C1013               C1014               C1015
##  Min.   :0.000e+00   Min.   :0.0000000   Min.   :0.0000000
##  1st Qu.:0.000e+00   1st Qu.:0.0002555   1st Qu.:0.0000511
##  Median :8.205e-05   Median :0.0007817   Median :0.0027266
##  Mean   :8.735e-04   Mean   :0.0012365   Mean   :0.0029672
##  3rd Qu.:6.373e-04   3rd Qu.:0.0011683   3rd Qu.:0.0042328
##  Max.   :3.862e-03   Max.   :0.0061008   Max.   :0.0094291
##      C1016               C1017               C1018
##  Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0001700
##  1st Qu.:0.0000000   1st Qu.:0.0000000   1st Qu.:0.0004441
##  Median :0.0000000   Median :0.0004401   Median :0.0013016
##  Mean   :0.0003617   Mean   :0.0038891   Mean   :0.0017151
##  3rd Qu.:0.0004476   3rd Qu.:0.0053870   3rd Qu.:0.0020647
##  Max.   :0.0023955   Max.   :0.0187287   Max.   :0.0071077
##      C1019               C1020               C1021
##  Min.   :0.0000000   Min.   :0.000e+00   Min.   :0.000000
##  1st Qu.:0.0000000   1st Qu.:0.000e+00   1st Qu.:0.000000
##  Median :0.0003566   Median :0.000e+00   Median :0.000816
##  Mean   :0.0006591   Mean   :7.048e-05   Mean   :0.002347
##  3rd Qu.:0.0009389   3rd Qu.:0.000e+00   3rd Qu.:0.005059
##  Max.   :0.0023944   Max.   :7.048e-04   Max.   :0.007382
##      C1022
##  Min.   :0.000e+00
##  1st Qu.:0.000e+00
##  Median :0.000e+00
##  Mean   :8.731e-05
##  3rd Qu.:1.032e-04
##  Max.   :4.004e-04
```

```
# Calculate distances
res.dist <- vegdist(resREL, method = "bray")
res.dist2 <- vegdist(t(resREL), method = "bray")

res.pcoa <- cmdscale(res.dist2, eig = TRUE, k = 3)



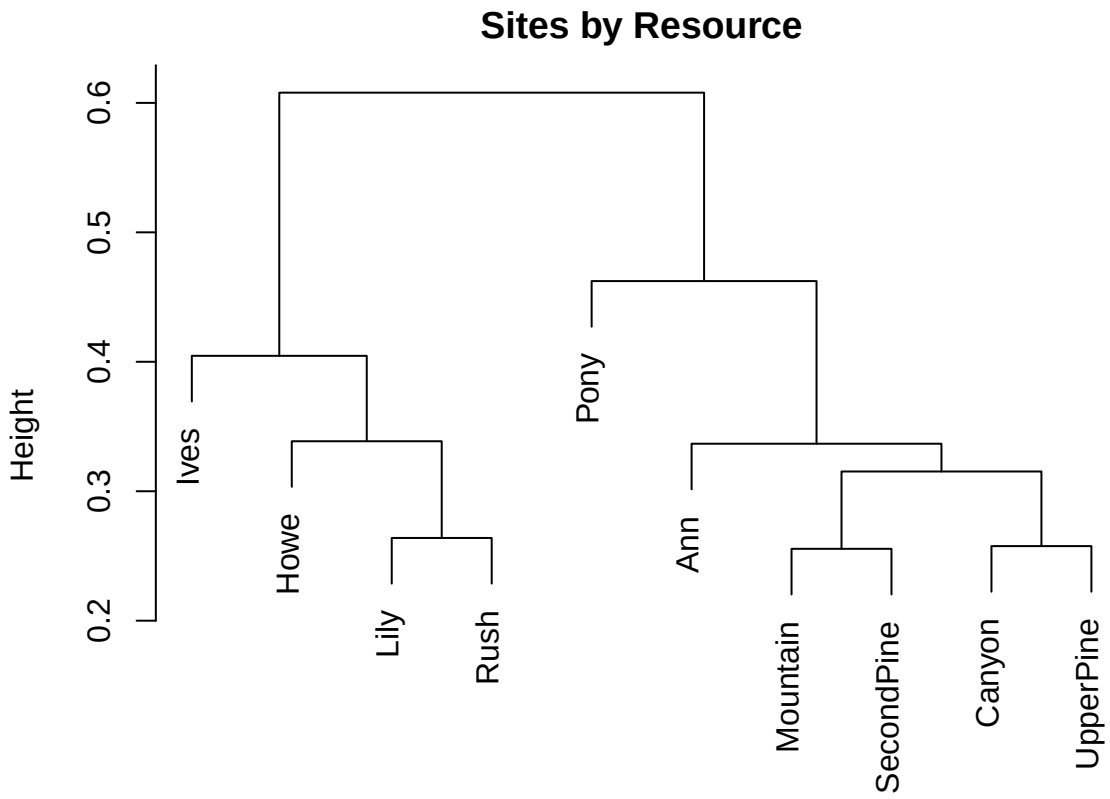
# Clustering
```

```
res.k <- kmeans(resREL, 5, iter.max = 10)

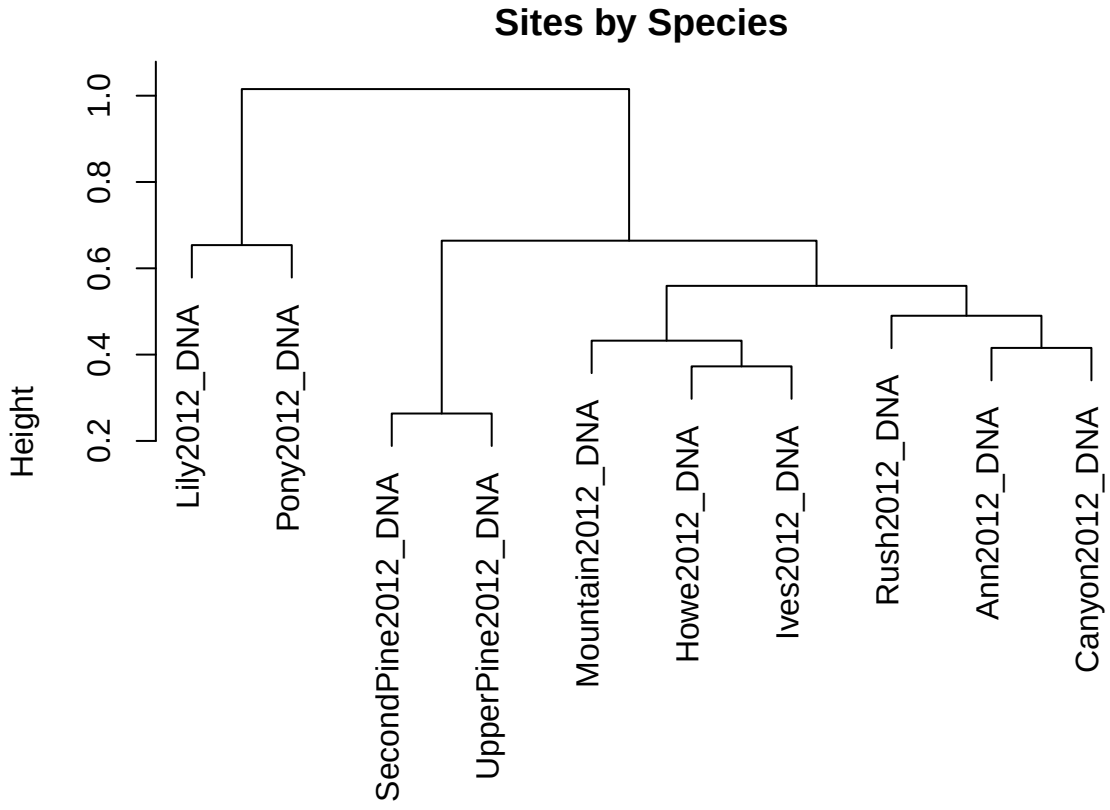
# plot(resREL, col = res.k$cluster)



# Perform Cluster Analysis
res.ward <- hclust(res.dist, method = "ward.D2")
# Plot Cluster
par(mar = c(1, 5, 2, 2) + 0.1)
plot(res.ward, main = "Sites by Resource")
```




```
bac.dist <- vegdist(OTUsREL[design$Year == "2012" &
                            design$Molecule == "DNA", ], method="bray")
bac.ward <- hclust(bac.dist, method = "ward.D2")
plot(bac.ward, main = "Sites by Species")
```


Sites by Species
Height
0.2
0.4
0.6
0.8
1.0
Lily2012_DNA
Pony2012_DNA
SecondPine2012_DNA
UpperPine2012_DNA
Mountain2012_DNA
Howe2012_DNA
Ives2012_DNA
Rush2012_DNA
Ann2012_DNA
Canyon2012_DNA