

## 6: Part 2 - Generalized Linear Models

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Spring 2022

### Objectives

2. Apply special cases of the GLM (ANOVA) to real datasets
3. Interpret and report the results of ANOVA in publication-style formats

### One-Way Analysis of Variance

It is a common situation when someone needs to determine whether three or more populations have equal means. To answer that question, we need to conduct a formal hypothesis test.

$H_{\{0\}}$ :  $\mu_{\{1\}} = \mu_{\{2\}} = \mu_{\{3\}} = \mu_{\{4\}} = \dots \mu_{\{k\}}$

$H_{\{A\}}$ : not all  $\mu_{\{j\}}$  are equal

The statistical method for conducting this test is called **Analysis of Variance - ANOVA**.

Example: A sandwich shop is interested in testing to see whether the mean value for customer orders is equal at the company's four store locations. Eight orders from each store are randomly selected.

Single factor - customer order value

Four levels - the four store locations

Sample size - 8 at each store

**Factor:** a quantity under examination in an experiment as a possible cause of variation in the response variable **Levels:** the categories, measurements, or strata of a factor of interest in the current experiment - also called **populations** **Balanced Design:** an experiment has a balanced design if the factor levels have equal sample sizes

**One-Way ANOVA Assumptions** \* All populations are normally distributed \* The population variances are equal \* The observations are independent - that is, the occurrence of any one individual value does not affect the probability that any other observation will occur

### Set up

```
getwd()
```

```
## [1] "/Users/ataliefischer/Desktop/EDA/Environmental_Data_Analytics_2022/Lessons"
```

```
library(tidyverse)
```

```
#install.packages("agricolae")
```

```
library(agricolae) #you may need to install/update package "htmltools" before installing and loading
```

```
Litter <- read.csv("../Data/Processed/NEON_NIWO_Litter_mass_trap_Processed.csv", stringsAsFactors = TRUE)
```

```
# Set date to date format
```

```
Litter$collectDate <- as.Date(Litter$collectDate , format = "%Y-%m-%d")
```

```
# Set theme
mytheme <- theme_classic(base_size = 14) +
  theme(axis.text = element_text(color = "black"),
        legend.position = "top")
theme_set(mytheme)
```

## One-way ANOVA

A one-way ANOVA is used when you have one categorical explanatory variable with more than two categories. In R, we can run the model with the function `lm` or `aov`, the latter of which will allow us to run post-hoc tests to determine pairwise differences.

Does total litter biomass differ among sites at the Niwot Ridge LTER?

```
# Wrangle the data
Litter.Totals <- Litter %>%
  group_by(plotID, collectDate, nlcdClass) %>%
  summarise(dryMass = sum(dryMass))
```

## ``summarise()`` has grouped output by 'plotID', 'collectDate'. You can override using the ``.groups`` argument

```
summary(Litter.Totals)
```

```
##      plotID      collectDate      nlcdClass      dryMass
## NIWO_040:19 Min. :2016-06-16 evergreenForest :74 Min. : 0.005
## NIWO_058:19 1st Qu.:2016-11-03 grasslandHerbaceous:47 1st Qu.: 1.749
## NIWO_062:19 Median :2018-06-07 shrubScrub :89 Median : 4.505
## NIWO_064:19 Mean :2018-02-06 Mean : 9.554
## NIWO_057:18 3rd Qu.:2018-10-25 3rd Qu.:11.238
## NIWO_061:18 Max. :2019-09-25 Max. :76.800
## (Other) :98
```

```
#check all value of plotID
summary(Litter.Totals$plotID)
```

```
## NIWO_040 NIWO_041 NIWO_046 NIWO_047 NIWO_051 NIWO_057 NIWO_058 NIWO_061
##      19      16      17      15      16      18      19      18
## NIWO_062 NIWO_063 NIWO_064 NIWO_067
##      19      18      19      16
```

```
# Test for normality.
# Note: the important assumption for GLMs is normality of residuals,
# not necessarily normality of raw data. See below when we plot the model.
# shapiro.test() performs the Shapiro-Wilk test of the null that data follows a normal distribution
```

```
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_040"]) #p-value < 0.05, we reject the null
```

```
##
## Shapiro-Wilk normality test
##
## data: Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_040"]
## W = 0.71852, p-value = 9.319e-05
```

```
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_041"])
```

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

```

## data: Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_041"]
## W = 0.75222, p-value = 0.0006757
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_046"])
```

```

##
## Shapiro-Wilk normality test
##
## data: Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_046"]
## W = 0.9464, p-value = 0.4021
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_047"])
```

```

##
## Shapiro-Wilk normality test
##
## data: Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_047"]
## W = 0.34128, p-value = 2.353e-07
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_051"])
```

```

##
## Shapiro-Wilk normality test
##
## data: Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_051"]
## W = 0.71303, p-value = 0.0002357
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_057"]) #normally distributed
```

```

##
## Shapiro-Wilk normality test
##
## data: Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_057"]
## W = 0.92093, p-value = 0.1343
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_058"])
```

```

##
## Shapiro-Wilk normality test
##
## data: Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_058"]
## W = 0.82393, p-value = 0.0026
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_061"])
```

```

##
## Shapiro-Wilk normality test
##
## data: Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_061"]
## W = 0.81814, p-value = 0.002772
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_062"])
```

```

##
## Shapiro-Wilk normality test
##
## data: Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_062"]
## W = 0.87455, p-value = 0.01728
```

```
shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_063"])

##
##  Shapiro-Wilk normality test
##
## data:  Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_063"]
## W = 0.70053, p-value = 8.099e-05

shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_064"]) # normally distributed

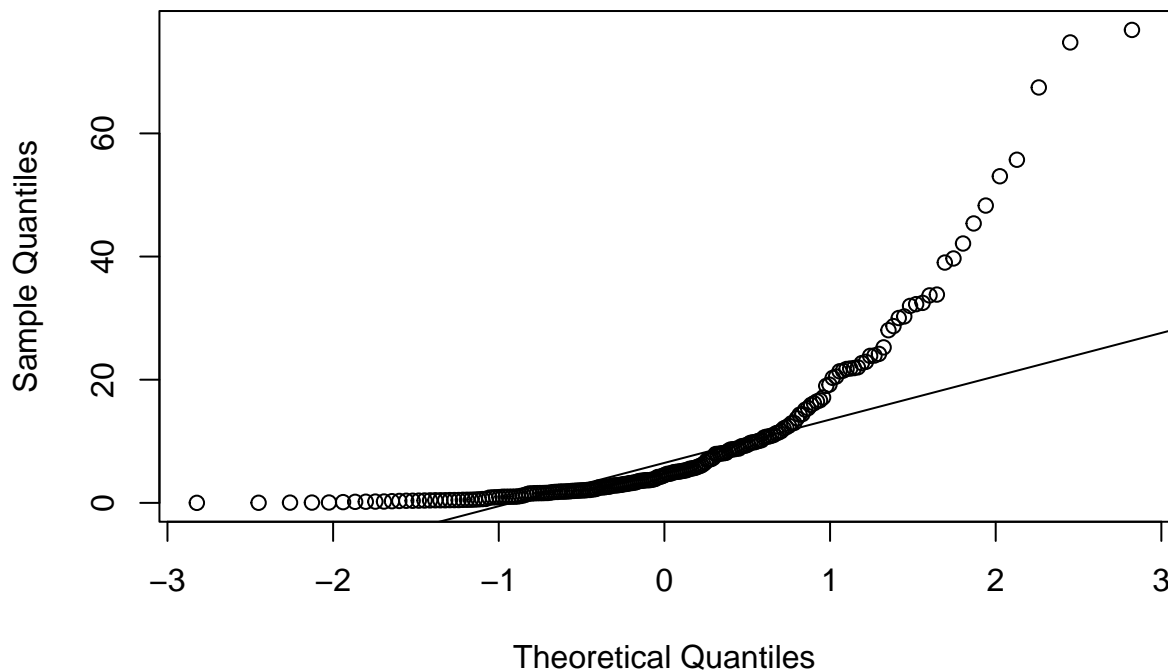
##
##  Shapiro-Wilk normality test
##
## data:  Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_064"]
## W = 0.70383, p-value = 6.176e-05

shapiro.test(Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_067"])

##
##  Shapiro-Wilk normality test
##
## data:  Litter.Totals$dryMass[Litter.Totals$plotID == "NIWO_067"]
## W = 0.642, p-value = 4.147e-05

#results: reject null in all except two: NIWO_057 and NIWO_046
qqnorm(Litter.Totals$dryMass); qqline(Litter.Totals$dryMass) #not normally distributed
```

## Normal Q-Q Plot



```
# Test for equal variance
# ANOVA is robust against departures from equal variance.
# bartlett.test() performs Bartlett's test of the null that the variances
#     in each of the groups (samples) are the same.
```

```
bartlett.test(Litter.Totals$dryMass ~ Litter.Totals$plotID)
```

```
##
## Bartlett test of homogeneity of variances
##
## data: Litter.Totals$dryMass by Litter.Totals$plotID
## Bartlett's K-squared = 158.67, df = 11, p-value < 2.2e-16
```

*#p-value < 0.05, we reject the null hypothesis that the data is normally distributed*

*#results: reject null i.e. variances are not equal*

*# Format ANOVA as aov*

```
Litter.Totals.anova <- aov(data = Litter.Totals, dryMass ~ plotID)
summary(Litter.Totals.anova)
```

```
##              Df Sum Sq Mean Sq F value    Pr(>F)
## plotID        11   7584    689.5    4.813 1.45e-06 ***
## Residuals    198  28363    143.2
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

*#results: reject null hypothesis i.e. difference between a pair of group means is statistically significant*

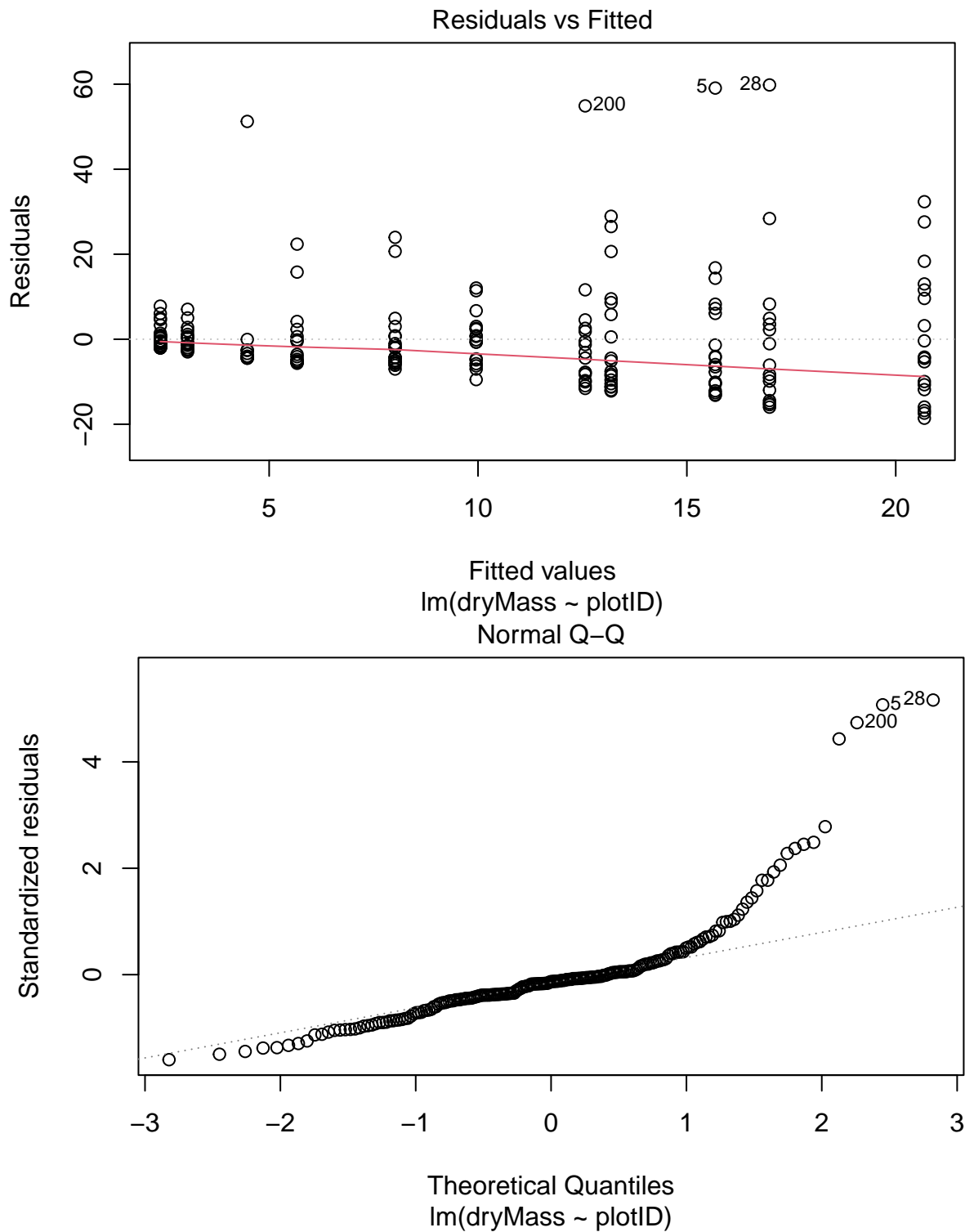
*# Format ANOVA as lm*

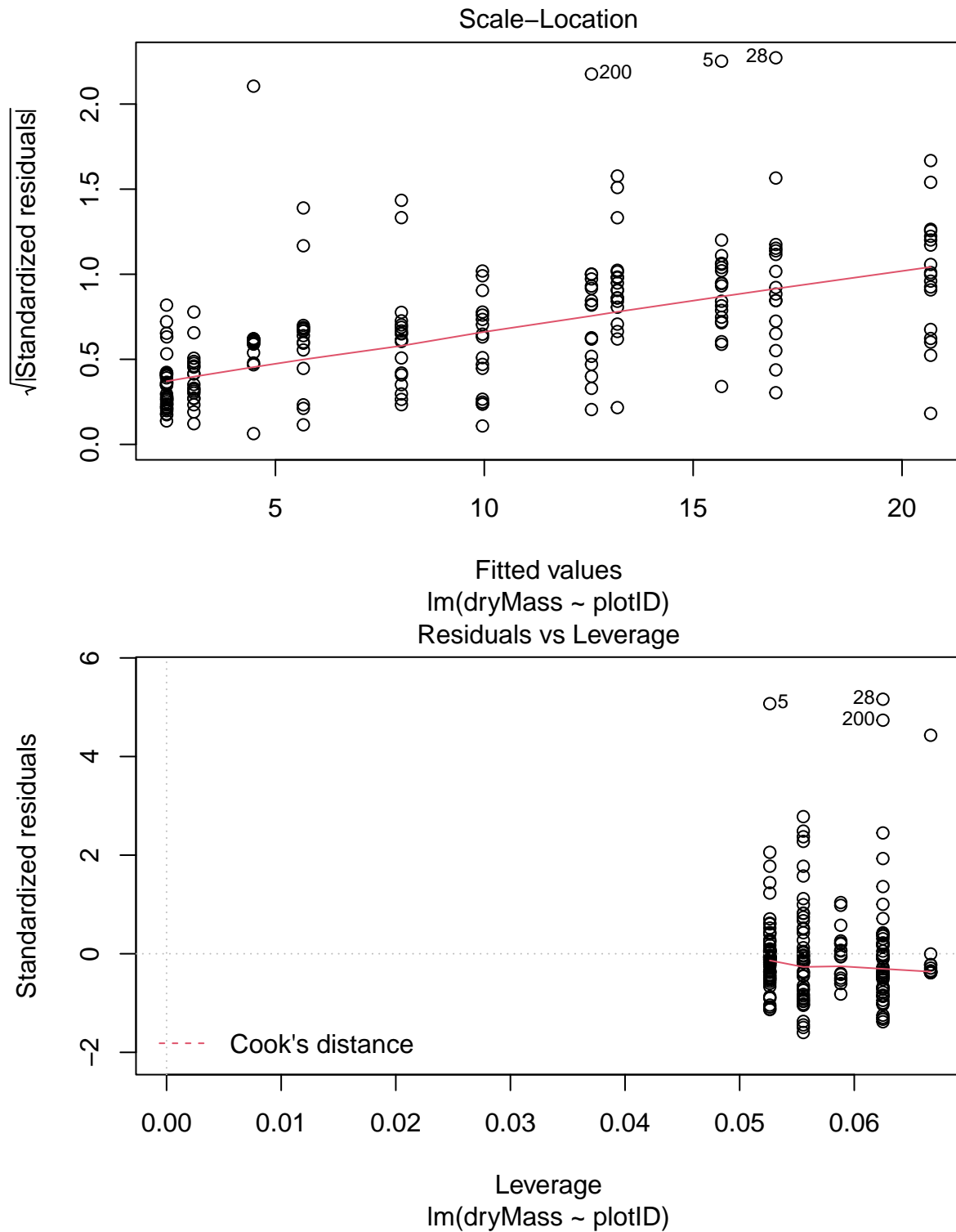
```
Litter.Totals.anova2 <- lm(data = Litter.Totals, dryMass ~ plotID)
summary(Litter.Totals.anova2)
```

```
##
## Call:
## lm(formula = dryMass ~ plotID, data = Litter.Totals)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -18.586  -5.419  -1.529   1.964  59.821
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    15.680      2.746    5.711 4.08e-08 ***
## plotIDNIWO_041     1.299      4.061    0.320 0.749396
## plotIDNIWO_046    -5.724      3.996   -1.432 0.153580
## plotIDNIWO_047   -11.204      4.134   -2.710 0.007315 **
## plotIDNIWO_051   -10.011      4.061   -2.465 0.014546 *
## plotIDNIWO_057     5.006      3.937    1.272 0.205013
## plotIDNIWO_058   -13.282      3.883   -3.420 0.000760 ***
## plotIDNIWO_061    -2.494      3.937   -0.633 0.527140
## plotIDNIWO_062   -12.632      3.883   -3.253 0.001342 **
## plotIDNIWO_063   -13.286      3.937   -3.375 0.000888 ***
## plotIDNIWO_064    -7.664      3.883   -1.974 0.049805 *
## plotIDNIWO_067    -3.114      4.061   -0.767 0.444110
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 11.97 on 198 degrees of freedom
## Multiple R-squared:  0.211, Adjusted R-squared:  0.1671
```

```
## F-statistic: 4.813 on 11 and 198 DF, p-value: 1.452e-06
```

```
# Checking model fit and assumptions  
# ANOVA is robust against departures from normality.  
plot(Litter.Totals.anova2)
```





### Post Hoc Test with ANOVA

When you use ANOVA to test the equality of at least three group means, statistically significant results indicate that not all of the group means are equal. However, ANOVA results do not identify which particular differences between pairs of means are significant. Use post hoc tests to explore differences between multiple group means. **Tukey HSD (Tukey Honest Significant Differences)** method is the most common for

comparing all possible group pairings.

```
# Post-hoc test
# TukeyHSD() computes Tukey Honest Significant Differences
TukeyHSD(Litter.Totals.anova)

## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = dryMass ~ plotID, data = Litter.Totals)
##
## $plotID
##              diff          lwr          upr          p adj
## NIWO_041-NIWO_040  1.299062500 -12.133507 14.7316317 1.0000000
## NIWO_046-NIWO_040 -5.723823529 -18.940183  7.4925361 0.9556786
## NIWO_047-NIWO_040 -11.203666667 -24.877141  2.4698079 0.2291635
## NIWO_051-NIWO_040 -10.011250000 -23.443819  3.4213192 0.3682118
## NIWO_057-NIWO_040  5.005833333  -8.015326 18.0269931 0.9817155
## NIWO_058-NIWO_040 -13.281578947 -26.125572 -0.4375861 0.0356138
## NIWO_061-NIWO_040 -2.493888889 -15.515049 10.5272709 0.9999695
## NIWO_062-NIWO_040 -12.632368421 -25.476361  0.2116244 0.0585895
## NIWO_063-NIWO_040 -13.286111111 -26.307271 -0.2649514 0.0409036
## NIWO_064-NIWO_040 -7.664210526 -20.508203  5.1797823 0.7105434
## NIWO_067-NIWO_040 -3.114062500 -16.546632 10.3185067 0.9997965
## NIWO_046-NIWO_041 -7.022886029 -20.811937  6.7661649 0.8732142
## NIWO_047-NIWO_041 -12.502729167 -26.730507  1.7250490 0.1467092
## NIWO_051-NIWO_041 -11.310312500 -25.306729  2.6861042 0.2478220
## NIWO_057-NIWO_041  3.706770833  -9.895301 17.3088429 0.9990520
## NIWO_058-NIWO_041 -14.580641447 -28.013211 -1.1480722 0.0207531
## NIWO_061-NIWO_041 -3.792951389 -17.395023  9.8091207 0.9988277
## NIWO_062-NIWO_041 -13.931430921 -27.364000 -0.4988617 0.0345161
## NIWO_063-NIWO_041 -14.585173611 -28.187246 -0.9831015 0.0239137
## NIWO_064-NIWO_041 -8.963273026 -22.395842  4.4692962 0.5465386
## NIWO_067-NIWO_041 -4.413125000 -18.409542  9.5832917 0.9964654
## NIWO_047-NIWO_046 -5.479843137 -19.503677  8.5439907 0.9792588
## NIWO_051-NIWO_046 -4.287426471 -18.076477  9.5016245 0.9968732
## NIWO_057-NIWO_046 10.729656863  -2.658943 24.1182569 0.2593203
## NIWO_058-NIWO_046 -7.557755418 -20.774115  5.6586042 0.7631683
## NIWO_061-NIWO_046  3.229934641 -10.158665 16.6185346 0.9997008
## NIWO_062-NIWO_046 -6.908544892 -20.124904  6.3078147 0.8526955
## NIWO_063-NIWO_046 -7.562287582 -20.950888  5.8263124 0.7772274
## NIWO_064-NIWO_046 -1.940386997 -15.156747 11.2759726 0.9999980
## NIWO_067-NIWO_046  2.609761029 -11.179290 16.3988120 0.9999730
## NIWO_051-NIWO_047  1.192416667 -13.035361 15.4201948 1.0000000
## NIWO_057-NIWO_047 16.209500000  2.369473 30.0495273 0.0078565
## NIWO_058-NIWO_047 -2.077912281 -15.751387 11.5955623 0.9999972
## NIWO_061-NIWO_047  8.709777778  -5.130249 22.5498050 0.6364556
## NIWO_062-NIWO_047 -1.428701754 -15.102176 12.2447728 0.9999999
## NIWO_063-NIWO_047 -2.082444444 -15.922472 11.7575828 0.9999975
## NIWO_064-NIWO_047  3.539456140 -10.134018 17.2129307 0.9994142
## NIWO_067-NIWO_047  8.089604167  -6.138174 22.3173823 0.7697669
## NIWO_057-NIWO_051 15.017083333  1.415011 28.6191554 0.0169404
## NIWO_058-NIWO_051 -3.270328947 -16.702898 10.1622403 0.9996733
## NIWO_061-NIWO_051  7.517361111  -6.084711 21.1194332 0.8006609
## NIWO_062-NIWO_051 -2.621118421 -16.053688 10.8114508 0.9999632
```



```

## NIWO_063-NIWO_051 -3.274861111 -16.876933 10.3272110 0.9997065
## NIWO_064-NIWO_051 2.347039474 -11.085530 15.7796087 0.9999880
## NIWO_067-NIWO_051 6.897187500 -7.099229 20.8936042 0.8959904
## NIWO_058-NIWO_057 -18.287412281 -31.308572 -5.2662525 0.0003779
## NIWO_061-NIWO_057 -7.499722222 -20.695670 5.6962260 0.7702539
## NIWO_062-NIWO_057 -17.638201754 -30.659361 -4.6170420 0.0007554
## NIWO_063-NIWO_057 -18.291944444 -31.487893 -5.0959962 0.0004883
## NIWO_064-NIWO_057 -12.670043860 -25.691204 0.3511159 0.0646857
## NIWO_067-NIWO_057 -8.119895833 -21.721968 5.4821763 0.7100063
## NIWO_061-NIWO_058 10.787690058 -2.233470 23.8088498 0.2148146
## NIWO_062-NIWO_058 0.649210526 -12.194782 13.4932034 1.0000000
## NIWO_063-NIWO_058 -0.004532164 -13.025692 13.0166276 1.0000000
## NIWO_064-NIWO_058 5.617368421 -7.226624 18.4613613 0.9525183
## NIWO_067-NIWO_058 10.167516447 -3.265053 23.6000857 0.3439343
## NIWO_062-NIWO_061 -10.138479532 -23.159639 2.8826802 0.3009668
## NIWO_063-NIWO_061 -10.792222222 -23.988170 2.4037260 0.2316348
## NIWO_064-NIWO_061 -5.170321637 -18.191481 7.8508381 0.9765523
## NIWO_067-NIWO_061 -0.620173611 -14.222246 12.9818985 1.0000000
## NIWO_063-NIWO_062 -0.653742690 -13.674902 12.3674170 1.0000000
## NIWO_064-NIWO_062 4.968157895 -7.875835 17.8121507 0.9808216
## NIWO_067-NIWO_062 9.518305921 -3.914263 22.9508752 0.4494776
## NIWO_064-NIWO_063 5.621900585 -7.399259 18.6430603 0.9566352
## NIWO_067-NIWO_063 10.172048611 -3.430023 23.7741207 0.3628551
## NIWO_067-NIWO_064 4.550148026 -8.882421 17.9827173 0.9934557

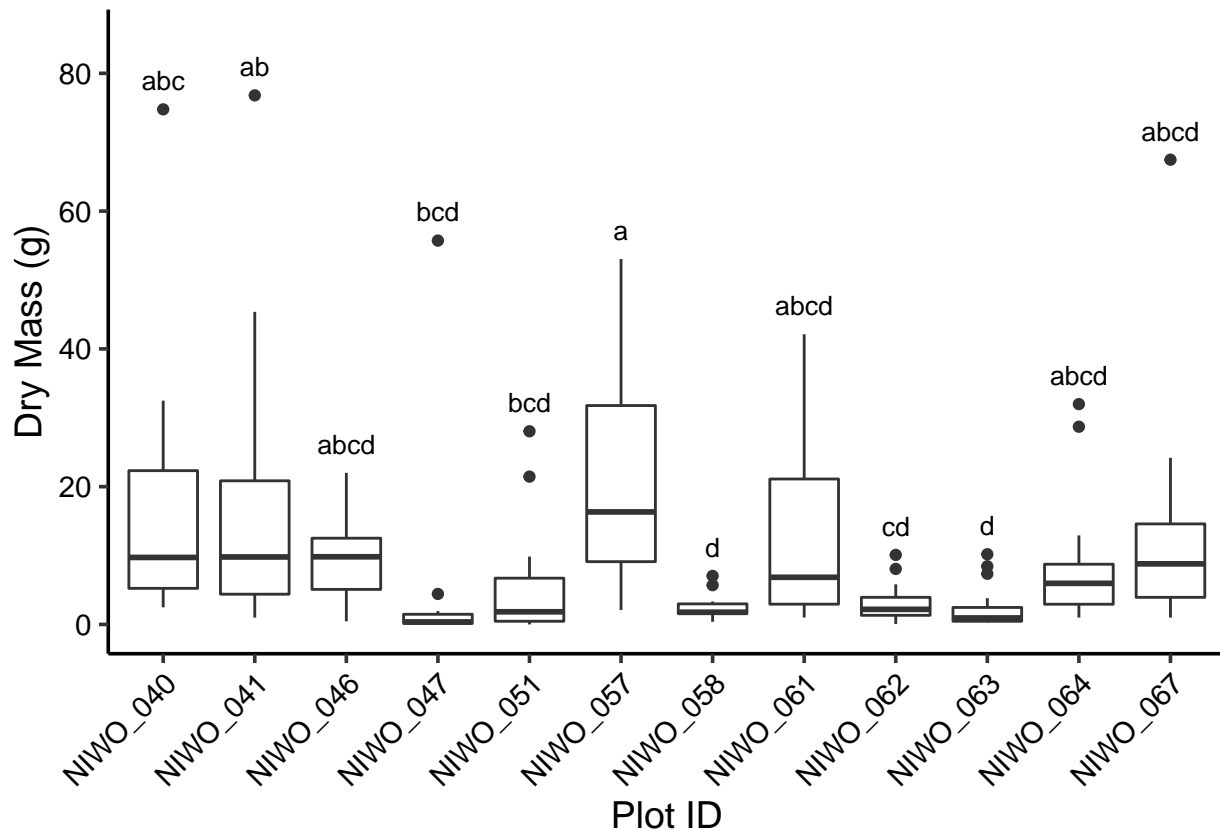
# Extract groupings for pairwise relationships
Litter.Totals.groups <- HSD.test(Litter.Totals.anova, "plotID", group = TRUE)
# group = TRUE --> group levels with the same mean
Litter.Totals.groups

## $statistics
##      MSerror Df      Mean      CV
## 143.2479 198 9.55381 125.2759
##
## $parameters
##      test name.t ntr StudentizedRange alpha
##      Tukey plotID 12          4.677704 0.05
##
## $means
##      dryMass      std r      Min      Max      Q25      Q50      Q75
## NIWO_040 15.680000 17.127210 19 2.485 74.770 5.23750 9.7250 22.32500
## NIWO_041 16.979063 19.748656 16 0.990 76.800 4.38875 9.7950 20.84750
## NIWO_046 9.956176 6.125677 17 0.455 22.010 5.08500 9.8200 12.52000
## NIWO_047 4.476333 14.224853 15 0.015 55.720 0.14500 0.3650 1.47500
## NIWO_051 5.668750 8.158336 16 0.005 28.040 0.46000 1.8350 6.71625
## NIWO_057 20.685833 15.634036 18 2.100 53.040 9.11250 16.3300 31.77125
## NIWO_058 2.398421 1.636032 19 0.385 7.045 1.56000 1.7750 2.98500
## NIWO_061 13.186111 13.620037 18 1.010 42.120 2.94125 6.8450 21.11125
## NIWO_062 3.047632 2.666352 19 0.060 10.095 1.32250 2.1900 3.93500
## NIWO_063 2.393889 3.068145 18 0.310 10.185 0.46125 0.9425 2.46625
## NIWO_064 8.015789 8.517745 19 1.000 31.985 2.93500 5.9650 8.74000
## NIWO_067 12.565938 16.021432 16 0.990 67.460 3.93125 8.7950 14.59375
##
## $comparison
## NULL

```

```
##
## $groups
##      dryMass groups
## NIWO_057 20.685833      a
## NIWO_041 16.979063      ab
## NIWO_040 15.680000      abc
## NIWO_061 13.186111     abcd
## NIWO_067 12.565938     abcd
## NIWO_046  9.956176     abcd
## NIWO_064  8.015789     abcd
## NIWO_051  5.668750      bcd
## NIWO_047  4.476333      bcd
## NIWO_062  3.047632       cd
## NIWO_058  2.398421       d
## NIWO_063  2.393889       d
##
## attr(,"class")
## [1] "group"

# Graph the results
Litter.Totals.plot <- ggplot(Litter.Totals, aes(x = plotID, y = dryMass)) +
  geom_boxplot() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  stat_summary(geom = "text", fun = max, vjust = -1, size = 3.5,
    label = c("abc", "ab", "abcd", "bcd", "bcd", "a",
      "d", "abcd", "cd", "d", "abcd", "abcd")) +
  labs(x = "Plot ID", y = "Dry Mass (g)") +
  ylim(0, 85)
print(Litter.Totals.plot)
```



What information does the output give us? How might we report this information in a report?

Re-order the sites so that they are grouped by those with the same mean

## TWO-WAY ANOVA

### Main effects

A two-way ANOVA allows us to examine the effects of two categorical explanatory variables on a continuous response variable. What if we wanted to know how litter masses varied across functional groups and land cover class?

```
# Format as aov
Litter.anova.2way <- aov(data = Litter, dryMass ~ functionalGroup + nlcdClass)
summary(Litter.anova.2way)

##               Df Sum Sq Mean Sq F value    Pr(>F)
## functionalGroup   7   6193   884.7   71.540 < 2e-16 ***
## nlcdClass         2    223   111.7    9.033 0.000125 ***
## Residuals       1682  20800    12.4
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

# Format as lm
Litter.anova.2way2 <- lm(data = Litter, dryMass ~ functionalGroup + nlcdClass)
summary(Litter.anova.2way2) #reject null hypothesis: mean between the groups are different

##
## Call:
## lm(formula = dryMass ~ functionalGroup + nlcdClass, data = Litter)
```

```
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -5.487 -0.784 -0.208  0.259 48.738
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.523322   0.263954   1.983 0.047571 *
## functionalGroupLeaves      0.002287   0.335011   0.007 0.994554
## functionalGroupMixed      1.647412   0.417281   3.948 8.21e-05 ***
## functionalGroupNeedles     5.654391   0.329491  17.161 < 2e-16 ***
## functionalGroupOther      0.037433   0.337609   0.111 0.911728
## functionalGroupSeeds     -0.005358   0.338383  -0.016 0.987370
## functionalGroupTwigs/branches 1.120138   0.332841   3.365 0.000782 ***
## functionalGroupWoody material 0.466337   0.330164   1.412 0.158005
## nlcdClassgrasslandHerbaceous -0.685663   0.230666  -2.973 0.002995 **
## nlcdClassshrubScrub      -0.782095   0.193758  -4.036 5.67e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.517 on 1682 degrees of freedom
## Multiple R-squared:  0.2357, Adjusted R-squared:  0.2317
## F-statistic: 57.65 on 9 and 1682 DF,  p-value: < 2.2e-16
# Run a post-hoc test for pairwise differences
TukeyHSD(Litter.anova.2way)

##      Tukey multiple comparisons of means
##      95% family-wise confidence level
##
## Fit: aov(formula = dryMass ~ functionalGroup + nlcdClass, data = Litter)
##
## $functionalGroup
##              diff              lwr              upr              p adj
## Leaves-Flowers -0.014519444 -1.03108186  1.00204297 1.0000000
## Mixed-Flowers  1.709115566  0.44356059  2.97467054 0.0011317
## Needles-Flowers 5.657419606  4.65752186  6.65731735 0.0000000
## Other-Flowers  0.027849771 -0.99667539  1.05237493 1.0000000
## Seeds-Flowers -0.012152778 -1.03903588  1.01473033 1.0000000
## Twigs/branches-Flowers 1.118146645  0.10807127  2.12822202 0.0181336
## Woody material-Flowers 0.483062238 -0.51881096  1.48493544 0.8269243
## Mixed-Leaves  1.723635010  0.46643987  2.98083015 0.0008712
## Needles-Leaves 5.671939050  4.68264348  6.66123462 0.0000000
## Other-Leaves  0.042369215 -0.97181126  1.05654969 1.0000000
## Seeds-Leaves  0.002366667 -1.01419574  1.01892908 1.0000000
## Twigs/branches-Leaves 1.132666089  0.13308494  2.13224724 0.0138750
## Woody material-Leaves 0.497581683 -0.49371047  1.48887383 0.7949699
## Needles-Mixed  3.948304040  2.70454523  5.19206285 0.0000000
## Other-Mixed -1.681265795 -2.94490826 -0.41762333 0.0014542
## Seeds-Mixed -1.721268344 -2.98682332 -0.45571337 0.0010019
## Twigs/branches-Mixed -0.590968921 -1.84292449  0.66098664 0.8421896
## Woody material-Mixed -1.226053328 -2.47140082  0.01929417 0.0572676
## Other-Needles -5.629569835 -6.62704585 -4.63209382 0.0000000
## Seeds-Needles -5.669572384 -6.66947013 -4.66967464 0.0000000
## Twigs/branches-Needles -4.539272961 -5.52190150 -3.55664442 0.0000000
```

```
## Woody material-Needles      -5.174357367 -6.14855268 -4.20016206 0.0000000
## Seeds-Other                 -0.040002548 -1.06452771  0.98452261 1.0000000
## Twigs/branches-Other        1.090296874  0.08261877  2.09797498 0.0232567
## Woody material-Other         0.455212468 -0.54424379  1.45466872 0.8655279
## Twigs/branches-Seeds        1.130299423  0.12022405  2.14037480 0.0160473
## Woody material-Seeds         0.495215016 -0.50665818  1.49708822 0.8076616
## Woody material-Twigs/branches -0.635084407 -1.61972305  0.34955424 0.5113474
##
## $nlcdClass
##                                diff          lwr          upr          p adj
## grasslandHerbaceous-evergreenForest -0.68360994 -1.2242079 -0.1430120 0.0085817
## shrubScrub-evergreenForest          -0.78026426 -1.2343255 -0.3262030 0.0001714
## shrubScrub-grasslandHerbaceous      -0.09665431 -0.6283874  0.4350788 0.9046605
```

## Interaction effects

We may expect the effects of functional group and land cover to be dependent on each other. For instance, we may expect needle biomass to be larger in evergreen forests than in other land types. In this case, we might choose to run an interaction effects two-way ANOVA, which will examine the individual effects of the explanatory variables as well as the interaction of the explanatory variables.

The output gives test statistics for each explanatory variable as well as the interaction effect of the explanatory variables. If the p-value for the interaction effect is less than 0.05, then we would consider the interaction among the explanatory variables to be significant.

```
# Format as aov
Litter.anova.2way3 <- aov(data = Litter, dryMass ~ functionalGroup * nlcdClass)
# use "*" to see interaction.
summary(Litter.anova.2way3) # interaction shown in summary using ":"
```

```
##              Df Sum Sq Mean Sq F value    Pr(>F)
## functionalGroup      7   6193    884.7    72.445 < 2e-16 ***
## nlcdClass            2    223    111.7     9.147 0.000112 ***
## functionalGroup:nlcdClass 14    431     30.8     2.521 0.001444 **
## Residuals          1668   20369     12.2
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Format as lm
Litter.anova.2way4 <- lm(data = Litter, dryMass ~ functionalGroup * nlcdClass)
summary(Litter.anova.2way4)
```

```
##
## Call:
## lm(formula = dryMass ~ functionalGroup * nlcdClass, data = Litter)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -6.612  -0.480  -0.058  -0.005   49.051
##
## Coefficients:
##              Estimate Std. Error
## (Intercept)      0.11963    0.39070
## functionalGroupLeaves -0.10360    0.55606
## functionalGroupMixed   1.50475    0.63800
## functionalGroupNeedles  7.31226    0.53696
```

```

## functionalGroupOther -0.03482 0.55606
## functionalGroupSeeds -0.04616 0.55606
## functionalGroupTwigs/branches 1.95967 0.54434
## functionalGroupWoody material 1.08431 0.53156
## nlcdClassgrasslandHerbaceous -0.11420 0.64223
## nlcdClassshrubScrub -0.10412 0.53838
## functionalGroupLeaves:nlcdClassgrasslandHerbaceous 0.12865 0.89410
## functionalGroupMixed:nlcdClassgrasslandHerbaceous -0.38118 1.13024
## functionalGroupNeedles:nlcdClassgrasslandHerbaceous -2.13880 0.87993
## functionalGroupOther:nlcdClassgrasslandHerbaceous 0.12606 0.90743
## functionalGroupSeeds:nlcdClassgrasslandHerbaceous 0.04615 0.90743
## functionalGroupTwigs/branches:nlcdClassgrasslandHerbaceous -1.01519 0.89462
## functionalGroupWoody material:nlcdClassgrasslandHerbaceous -1.04086 0.88971
## functionalGroupLeaves:nlcdClassshrubScrub 0.14703 0.75915
## functionalGroupMixed:nlcdClassshrubScrub 0.74593 0.93038
## functionalGroupNeedles:nlcdClassshrubScrub -2.92148 0.74258
## functionalGroupOther:nlcdClassshrubScrub 0.08589 0.76101
## functionalGroupSeeds:nlcdClassshrubScrub 0.05944 0.76295
## functionalGroupTwigs/branches:nlcdClassshrubScrub -1.49559 0.74881
## functionalGroupWoody material:nlcdClassshrubScrub -0.97185 0.73957
## t value Pr(>|t|)
## (Intercept) 0.306 0.759502
## functionalGroupLeaves -0.186 0.852224
## functionalGroupMixed 2.359 0.018462 *
## functionalGroupNeedles 13.618 < 2e-16 ***
## functionalGroupOther -0.063 0.950081
## functionalGroupSeeds -0.083 0.933846
## functionalGroupTwigs/branches 3.600 0.000327 ***
## functionalGroupWoody material 2.040 0.041519 *
## nlcdClassgrasslandHerbaceous -0.178 0.858888
## nlcdClassshrubScrub -0.193 0.846673
## functionalGroupLeaves:nlcdClassgrasslandHerbaceous 0.144 0.885611
## functionalGroupMixed:nlcdClassgrasslandHerbaceous -0.337 0.735969
## functionalGroupNeedles:nlcdClassgrasslandHerbaceous -2.431 0.015177 *
## functionalGroupOther:nlcdClassgrasslandHerbaceous 0.139 0.889531
## functionalGroupSeeds:nlcdClassgrasslandHerbaceous 0.051 0.959441
## functionalGroupTwigs/branches:nlcdClassgrasslandHerbaceous -1.135 0.256634
## functionalGroupWoody material:nlcdClassgrasslandHerbaceous -1.170 0.242213
## functionalGroupLeaves:nlcdClassshrubScrub 0.194 0.846453
## functionalGroupMixed:nlcdClassshrubScrub 0.802 0.422814
## functionalGroupNeedles:nlcdClassshrubScrub -3.934 8.69e-05 ***
## functionalGroupOther:nlcdClassshrubScrub 0.113 0.910155
## functionalGroupSeeds:nlcdClassshrubScrub 0.078 0.937915
## functionalGroupTwigs/branches:nlcdClassshrubScrub -1.997 0.045956 *
## functionalGroupWoody material:nlcdClassshrubScrub -1.314 0.189001
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.494 on 1668 degrees of freedom
## Multiple R-squared: 0.2516, Adjusted R-squared: 0.2413
## F-statistic: 24.38 on 23 and 1668 DF, p-value: < 2.2e-16

```

If the interaction is significant, we interpret pairwise differences for the interaction. If the interaction is not significant, we interpret differences for the main effects only.

```
# Run a post-hoc test for pairwise differences
TukeyHSD(Litter.anova.2way3)
```

```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = dryMass ~ functionalGroup * nlcdClass, data = Litter)
##
## $functionalGroup
##
```

	diff	lwr	upr	p adj
Leaves-Flowers	-0.014519444	-1.02471810	0.9956792	1.0000000
Mixed-Flowers	1.709115566	0.45148307	2.9667481	0.0010161
Needles-Flowers	5.657419606	4.66378130	6.6510579	0.0000000
Other-Flowers	0.027849771	-0.99026179	1.0459613	1.0000000
Seeds-Flowers	-0.012152778	-1.03260752	1.0083020	1.0000000
Twigs/branches-Flowers	1.118146645	0.11439442	2.1218989	0.0168974
Woody material-Flowers	0.483062238	-0.51253916	1.4786636	0.8221892
Mixed-Leaves	1.723635010	0.47431001	2.9729600	0.0007796
Needles-Leaves	5.671939050	4.68883655	6.6550416	0.0000000
Other-Leaves	0.042369215	-0.96546241	1.0502008	1.0000000
Seeds-Leaves	0.002366667	-1.00783199	1.0125653	1.0000000
Twigs/branches-Leaves	1.132666089	0.13934239	2.1259898	0.0128809
Woody material-Leaves	0.497581683	-0.48750490	1.4826683	0.7896098
Needles-Mixed	3.948304040	2.71233125	5.1842768	0.0000000
Other-Mixed	-1.681265795	-2.93699776	-0.4255338	0.0013099
Seeds-Mixed	-1.721268344	-2.97890084	-0.4636358	0.0008982
Twigs/branches-Mixed	-0.590968921	-1.83508715	0.6531493	0.8377747
Woody material-Mixed	-1.226053328	-2.46360485	0.0114982	0.0542582
Other-Needles	-5.629569835	-6.62080157	-4.6383381	0.0000000
Seeds-Needles	-5.669572384	-6.66321069	-4.6759341	0.0000000
Twigs/branches-Needles	-4.539272961	-5.51575017	-3.5627957	0.0000000
Woody material-Needles	-5.174357367	-6.14245414	-4.2062606	0.0000000
Seeds-Other	-0.040002548	-1.05811410	0.9781090	1.0000000
Twigs/branches-Other	1.090296874	0.08892692	2.0916668	0.0217473
Woody material-Other	0.455212468	-0.53798711	1.4484120	0.8616311
Twigs/branches-Seeds	1.130299423	0.12654720	2.1340516	0.0149277
Woody material-Seeds	0.495215016	-0.50038638	1.4908164	0.8025426
Woody material-Twigs/branches	-0.635084407	-1.61355913	0.3433903	0.5028434

```
##
## $nlcdClass
##
```

	diff	lwr	upr	p adj
grasslandHerbaceous-evergreenForest	-0.68360994	-1.2208220	-0.1463979	0.0080895
shrubScrub-evergreenForest	-0.78026426	-1.2314816	-0.3290469	0.0001541
shrubScrub-grasslandHerbaceous	-0.09665431	-0.6250571	0.4317485	0.9035143

```
##
## `$functionalGroup:nlcdClass`
##
```

	diff
Leaves:evergreenForest-Flowers:evergreenForest	-1.035994e-01
Mixed:evergreenForest-Flowers:evergreenForest	1.504750e+00
Needles:evergreenForest-Flowers:evergreenForest	7.312264e+00
Other:evergreenForest-Flowers:evergreenForest	-3.481731e-02
Seeds:evergreenForest-Flowers:evergreenForest	-4.616346e-02
Twigs/branches:evergreenForest-Flowers:evergreenForest	1.959669e+00
Woody material:evergreenForest-Flowers:evergreenForest	1.084311e+00

## Flowers:grasslandHerbaceous-Flowers:evergreenForest	-1.141995e-01
## Leaves:grasslandHerbaceous-Flowers:evergreenForest	-8.915330e-02
## Mixed:grasslandHerbaceous-Flowers:evergreenForest	1.009375e+00
## Needles:grasslandHerbaceous-Flowers:evergreenForest	5.059264e+00
## Other:grasslandHerbaceous-Flowers:evergreenForest	-2.295833e-02
## Seeds:grasslandHerbaceous-Flowers:evergreenForest	-1.142083e-01
## Twigs/branches:grasslandHerbaceous-Flowers:evergreenForest	8.302750e-01
## Woody material:grasslandHerbaceous-Flowers:evergreenForest	-7.074745e-02
## Flowers:shrubScrub-Flowers:evergreenForest	-1.041194e-01
## Leaves:shrubScrub-Flowers:evergreenForest	-6.068883e-02
## Mixed:shrubScrub-Flowers:evergreenForest	2.146559e+00
## Needles:shrubScrub-Flowers:evergreenForest	4.286664e+00
## Other:shrubScrub-Flowers:evergreenForest	-5.304891e-02
## Seeds:shrubScrub-Flowers:evergreenForest	-9.084722e-02
## Twigs/branches:shrubScrub-Flowers:evergreenForest	3.599583e-01
## Woody material:shrubScrub-Flowers:evergreenForest	8.343750e-03
## Mixed:evergreenForest-Leaves:evergreenForest	1.608349e+00
## Needles:evergreenForest-Leaves:evergreenForest	7.415863e+00
## Other:evergreenForest-Leaves:evergreenForest	6.878205e-02
## Seeds:evergreenForest-Leaves:evergreenForest	5.743590e-02
## Twigs/branches:evergreenForest-Leaves:evergreenForest	2.063268e+00
## Woody material:evergreenForest-Leaves:evergreenForest	1.187911e+00
## Flowers:grasslandHerbaceous-Leaves:evergreenForest	-1.060011e-02
## Leaves:grasslandHerbaceous-Leaves:evergreenForest	1.444606e-02
## Mixed:grasslandHerbaceous-Leaves:evergreenForest	1.112974e+00
## Needles:grasslandHerbaceous-Leaves:evergreenForest	5.162863e+00
## Other:grasslandHerbaceous-Leaves:evergreenForest	8.064103e-02
## Seeds:grasslandHerbaceous-Leaves:evergreenForest	-1.060897e-02
## Twigs/branches:grasslandHerbaceous-Leaves:evergreenForest	9.338744e-01
## Woody material:grasslandHerbaceous-Leaves:evergreenForest	3.285191e-02
## Flowers:shrubScrub-Leaves:evergreenForest	-5.200230e-04
## Leaves:shrubScrub-Leaves:evergreenForest	4.291053e-02
## Mixed:shrubScrub-Leaves:evergreenForest	2.250159e+00
## Needles:shrubScrub-Leaves:evergreenForest	4.390263e+00
## Other:shrubScrub-Leaves:evergreenForest	5.055045e-02
## Seeds:shrubScrub-Leaves:evergreenForest	1.275214e-02
## Twigs/branches:shrubScrub-Leaves:evergreenForest	4.635577e-01
## Woody material:shrubScrub-Leaves:evergreenForest	1.119431e-01
## Needles:evergreenForest-Mixed:evergreenForest	5.807514e+00
## Other:evergreenForest-Mixed:evergreenForest	-1.539567e+00
## Seeds:evergreenForest-Mixed:evergreenForest	-1.550913e+00
## Twigs/branches:evergreenForest-Mixed:evergreenForest	4.549191e-01
## Woody material:evergreenForest-Mixed:evergreenForest	-4.204388e-01
## Flowers:grasslandHerbaceous-Mixed:evergreenForest	-1.618949e+00
## Leaves:grasslandHerbaceous-Mixed:evergreenForest	-1.593903e+00
## Mixed:grasslandHerbaceous-Mixed:evergreenForest	-4.953750e-01
## Needles:grasslandHerbaceous-Mixed:evergreenForest	3.554514e+00
## Other:grasslandHerbaceous-Mixed:evergreenForest	-1.527708e+00
## Seeds:grasslandHerbaceous-Mixed:evergreenForest	-1.618958e+00
## Twigs/branches:grasslandHerbaceous-Mixed:evergreenForest	-6.744750e-01
## Woody material:grasslandHerbaceous-Mixed:evergreenForest	-1.575497e+00
## Flowers:shrubScrub-Mixed:evergreenForest	-1.608869e+00
## Leaves:shrubScrub-Mixed:evergreenForest	-1.565439e+00
## Mixed:shrubScrub-Mixed:evergreenForest	6.418092e-01



## Needles:shrubScrub-Mixed:evergreenForest	2.781914e+00
## Other:shrubScrub-Mixed:evergreenForest	-1.557799e+00
## Seeds:shrubScrub-Mixed:evergreenForest	-1.595597e+00
## Twigs/branches:shrubScrub-Mixed:evergreenForest	-1.144792e+00
## Woody material:shrubScrub-Mixed:evergreenForest	-1.496406e+00
## Other:evergreenForest-Needles:evergreenForest	-7.347081e+00
## Seeds:evergreenForest-Needles:evergreenForest	-7.358427e+00
## Twigs/branches:evergreenForest-Needles:evergreenForest	-5.352595e+00
## Woody material:evergreenForest-Needles:evergreenForest	-6.227953e+00
## Flowers:grasslandHerbaceous-Needles:evergreenForest	-7.426463e+00
## Leaves:grasslandHerbaceous-Needles:evergreenForest	-7.401417e+00
## Mixed:grasslandHerbaceous-Needles:evergreenForest	-6.302889e+00
## Needles:grasslandHerbaceous-Needles:evergreenForest	-2.253000e+00
## Other:grasslandHerbaceous-Needles:evergreenForest	-7.335222e+00
## Seeds:grasslandHerbaceous-Needles:evergreenForest	-7.426472e+00
## Twigs/branches:grasslandHerbaceous-Needles:evergreenForest	-6.481989e+00
## Woody material:grasslandHerbaceous-Needles:evergreenForest	-7.383011e+00
## Flowers:shrubScrub-Needles:evergreenForest	-7.416383e+00
## Leaves:shrubScrub-Needles:evergreenForest	-7.372953e+00
## Mixed:shrubScrub-Needles:evergreenForest	-5.165705e+00
## Needles:shrubScrub-Needles:evergreenForest	-3.025600e+00
## Other:shrubScrub-Needles:evergreenForest	-7.365313e+00
## Seeds:shrubScrub-Needles:evergreenForest	-7.403111e+00
## Twigs/branches:shrubScrub-Needles:evergreenForest	-6.952306e+00
## Woody material:shrubScrub-Needles:evergreenForest	-7.303920e+00
## Seeds:evergreenForest-Other:evergreenForest	-1.134615e-02
## Twigs/branches:evergreenForest-Other:evergreenForest	1.994486e+00
## Woody material:evergreenForest-Other:evergreenForest	1.119128e+00
## Flowers:grasslandHerbaceous-Other:evergreenForest	-7.938216e-02
## Leaves:grasslandHerbaceous-Other:evergreenForest	-5.433599e-02
## Mixed:grasslandHerbaceous-Other:evergreenForest	1.044192e+00
## Needles:grasslandHerbaceous-Other:evergreenForest	5.094081e+00
## Other:grasslandHerbaceous-Other:evergreenForest	1.185897e-02
## Seeds:grasslandHerbaceous-Other:evergreenForest	-7.939103e-02
## Twigs/branches:grasslandHerbaceous-Other:evergreenForest	8.650923e-01
## Woody material:grasslandHerbaceous-Other:evergreenForest	-3.593014e-02
## Flowers:shrubScrub-Other:evergreenForest	-6.930207e-02
## Leaves:shrubScrub-Other:evergreenForest	-2.587152e-02
## Mixed:shrubScrub-Other:evergreenForest	2.181377e+00
## Needles:shrubScrub-Other:evergreenForest	4.321481e+00
## Other:shrubScrub-Other:evergreenForest	-1.823161e-02
## Seeds:shrubScrub-Other:evergreenForest	-5.602991e-02
## Twigs/branches:shrubScrub-Other:evergreenForest	3.947756e-01
## Woody material:shrubScrub-Other:evergreenForest	4.316106e-02
## Twigs/branches:evergreenForest-Seeds:evergreenForest	2.005833e+00
## Woody material:evergreenForest-Seeds:evergreenForest	1.130475e+00
## Flowers:grasslandHerbaceous-Seeds:evergreenForest	-6.803601e-02
## Leaves:grasslandHerbaceous-Seeds:evergreenForest	-4.298984e-02
## Mixed:grasslandHerbaceous-Seeds:evergreenForest	1.055538e+00
## Needles:grasslandHerbaceous-Seeds:evergreenForest	5.105427e+00
## Other:grasslandHerbaceous-Seeds:evergreenForest	2.320513e-02
## Seeds:grasslandHerbaceous-Seeds:evergreenForest	-6.804487e-02
## Twigs/branches:grasslandHerbaceous-Seeds:evergreenForest	8.764385e-01
## Woody material:grasslandHerbaceous-Seeds:evergreenForest	-2.458399e-02

## Flowers:shrubScrub-Seeds:evergreenForest	-5.795592e-02
## Leaves:shrubScrub-Seeds:evergreenForest	-1.452537e-02
## Mixed:shrubScrub-Seeds:evergreenForest	2.192723e+00
## Needles:shrubScrub-Seeds:evergreenForest	4.332827e+00
## Other:shrubScrub-Seeds:evergreenForest	-6.885452e-03
## Seeds:shrubScrub-Seeds:evergreenForest	-4.468376e-02
## Twigs/branches:shrubScrub-Seeds:evergreenForest	4.061218e-01
## Woody material:shrubScrub-Seeds:evergreenForest	5.450721e-02
## Woody material:evergreenForest-Twigs/branches:evergreenForest	-8.753579e-01
## Flowers:grasslandHerbaceous-Twigs/branches:evergreenForest	-2.073869e+00
## Leaves:grasslandHerbaceous-Twigs/branches:evergreenForest	-2.048822e+00
## Mixed:grasslandHerbaceous-Twigs/branches:evergreenForest	-9.502941e-01
## Needles:grasslandHerbaceous-Twigs/branches:evergreenForest	3.099595e+00
## Other:grasslandHerbaceous-Twigs/branches:evergreenForest	-1.982627e+00
## Seeds:grasslandHerbaceous-Twigs/branches:evergreenForest	-2.073877e+00
## Twigs/branches:grasslandHerbaceous-Twigs/branches:evergreenForest	-1.129394e+00
## Woody material:grasslandHerbaceous-Twigs/branches:evergreenForest	-2.030417e+00
## Flowers:shrubScrub-Twigs/branches:evergreenForest	-2.063788e+00
## Leaves:shrubScrub-Twigs/branches:evergreenForest	-2.020358e+00
## Mixed:shrubScrub-Twigs/branches:evergreenForest	1.868901e-01
## Needles:shrubScrub-Twigs/branches:evergreenForest	2.326995e+00
## Other:shrubScrub-Twigs/branches:evergreenForest	-2.012718e+00
## Seeds:shrubScrub-Twigs/branches:evergreenForest	-2.050516e+00
## Twigs/branches:shrubScrub-Twigs/branches:evergreenForest	-1.599711e+00
## Woody material:shrubScrub-Twigs/branches:evergreenForest	-1.951325e+00
## Flowers:grasslandHerbaceous-Woody material:evergreenForest	-1.198511e+00
## Leaves:grasslandHerbaceous-Woody material:evergreenForest	-1.173464e+00
## Mixed:grasslandHerbaceous-Woody material:evergreenForest	-7.493617e-02
## Needles:grasslandHerbaceous-Woody material:evergreenForest	3.974953e+00
## Other:grasslandHerbaceous-Woody material:evergreenForest	-1.107270e+00
## Seeds:grasslandHerbaceous-Woody material:evergreenForest	-1.198520e+00
## Twigs/branches:grasslandHerbaceous-Woody material:evergreenForest	-2.540362e-01
## Woody material:grasslandHerbaceous-Woody material:evergreenForest	-1.155059e+00
## Flowers:shrubScrub-Woody material:evergreenForest	-1.188431e+00
## Leaves:shrubScrub-Woody material:evergreenForest	-1.145000e+00
## Mixed:shrubScrub-Woody material:evergreenForest	1.062248e+00
## Needles:shrubScrub-Woody material:evergreenForest	3.202352e+00
## Other:shrubScrub-Woody material:evergreenForest	-1.137360e+00
## Seeds:shrubScrub-Woody material:evergreenForest	-1.175158e+00
## Twigs/branches:shrubScrub-Woody material:evergreenForest	-7.243528e-01
## Woody material:shrubScrub-Woody material:evergreenForest	-1.075967e+00
## Leaves:grasslandHerbaceous-Flowers:grasslandHerbaceous	2.504617e-02
## Mixed:grasslandHerbaceous-Flowers:grasslandHerbaceous	1.123574e+00
## Needles:grasslandHerbaceous-Flowers:grasslandHerbaceous	5.173463e+00
## Other:grasslandHerbaceous-Flowers:grasslandHerbaceous	9.124113e-02
## Seeds:grasslandHerbaceous-Flowers:grasslandHerbaceous	-8.865248e-06
## Twigs/branches:grasslandHerbaceous-Flowers:grasslandHerbaceous	9.444745e-01
## Woody material:grasslandHerbaceous-Flowers:grasslandHerbaceous	4.345202e-02
## Flowers:shrubScrub-Flowers:grasslandHerbaceous	1.008009e-02
## Leaves:shrubScrub-Flowers:grasslandHerbaceous	5.351064e-02
## Mixed:shrubScrub-Flowers:grasslandHerbaceous	2.260759e+00
## Needles:shrubScrub-Flowers:grasslandHerbaceous	4.400863e+00
## Other:shrubScrub-Flowers:grasslandHerbaceous	6.115056e-02
## Seeds:shrubScrub-Flowers:grasslandHerbaceous	2.335225e-02

## Twigs/branches:shrubScrub-Flowers:grasslandHerbaceous	4.741578e-01
## Woody material:shrubScrub-Flowers:grasslandHerbaceous	1.225432e-01
## Mixed:grasslandHerbaceous-Leaves:grasslandHerbaceous	1.098528e+00
## Needles:grasslandHerbaceous-Leaves:grasslandHerbaceous	5.148417e+00
## Other:grasslandHerbaceous-Leaves:grasslandHerbaceous	6.619497e-02
## Seeds:grasslandHerbaceous-Leaves:grasslandHerbaceous	-2.505503e-02
## Twigs/branches:grasslandHerbaceous-Leaves:grasslandHerbaceous	9.194283e-01
## Woody material:grasslandHerbaceous-Leaves:grasslandHerbaceous	1.840585e-02
## Flowers:shrubScrub-Leaves:grasslandHerbaceous	-1.496608e-02
## Leaves:shrubScrub-Leaves:grasslandHerbaceous	2.846447e-02
## Mixed:shrubScrub-Leaves:grasslandHerbaceous	2.235713e+00
## Needles:shrubScrub-Leaves:grasslandHerbaceous	4.375817e+00
## Other:shrubScrub-Leaves:grasslandHerbaceous	3.610439e-02
## Seeds:shrubScrub-Leaves:grasslandHerbaceous	-1.693920e-03
## Twigs/branches:shrubScrub-Leaves:grasslandHerbaceous	4.491116e-01
## Woody material:shrubScrub-Leaves:grasslandHerbaceous	9.749705e-02
## Needles:grasslandHerbaceous-Mixed:grasslandHerbaceous	4.049889e+00
## Other:grasslandHerbaceous-Mixed:grasslandHerbaceous	-1.032333e+00
## Seeds:grasslandHerbaceous-Mixed:grasslandHerbaceous	-1.123583e+00
## Twigs/branches:grasslandHerbaceous-Mixed:grasslandHerbaceous	-1.791000e-01
## Woody material:grasslandHerbaceous-Mixed:grasslandHerbaceous	-1.080122e+00
## Flowers:shrubScrub-Mixed:grasslandHerbaceous	-1.113494e+00
## Leaves:shrubScrub-Mixed:grasslandHerbaceous	-1.070064e+00
## Mixed:shrubScrub-Mixed:grasslandHerbaceous	1.137184e+00
## Needles:shrubScrub-Mixed:grasslandHerbaceous	3.277289e+00
## Other:shrubScrub-Mixed:grasslandHerbaceous	-1.062424e+00
## Seeds:shrubScrub-Mixed:grasslandHerbaceous	-1.100222e+00
## Twigs/branches:shrubScrub-Mixed:grasslandHerbaceous	-6.494167e-01
## Woody material:shrubScrub-Mixed:grasslandHerbaceous	-1.001031e+00
## Other:grasslandHerbaceous-Needles:grasslandHerbaceous	-5.082222e+00
## Seeds:grasslandHerbaceous-Needles:grasslandHerbaceous	-5.173472e+00
## Twigs/branches:grasslandHerbaceous-Needles:grasslandHerbaceous	-4.228989e+00
## Woody material:grasslandHerbaceous-Needles:grasslandHerbaceous	-5.130011e+00
## Flowers:shrubScrub-Needles:grasslandHerbaceous	-5.163383e+00
## Leaves:shrubScrub-Needles:grasslandHerbaceous	-5.119953e+00
## Mixed:shrubScrub-Needles:grasslandHerbaceous	-2.912705e+00
## Needles:shrubScrub-Needles:grasslandHerbaceous	-7.726002e-01
## Other:shrubScrub-Needles:grasslandHerbaceous	-5.112313e+00
## Seeds:shrubScrub-Needles:grasslandHerbaceous	-5.150111e+00
## Twigs/branches:shrubScrub-Needles:grasslandHerbaceous	-4.699306e+00
## Woody material:shrubScrub-Needles:grasslandHerbaceous	-5.050920e+00
## Seeds:grasslandHerbaceous-Other:grasslandHerbaceous	-9.125000e-02
## Twigs/branches:grasslandHerbaceous-Other:grasslandHerbaceous	8.532333e-01
## Woody material:grasslandHerbaceous-Other:grasslandHerbaceous	-4.778912e-02
## Flowers:shrubScrub-Other:grasslandHerbaceous	-8.116105e-02
## Leaves:shrubScrub-Other:grasslandHerbaceous	-3.773050e-02
## Mixed:shrubScrub-Other:grasslandHerbaceous	2.169518e+00
## Needles:shrubScrub-Other:grasslandHerbaceous	4.309622e+00
## Other:shrubScrub-Other:grasslandHerbaceous	-3.009058e-02
## Seeds:shrubScrub-Other:grasslandHerbaceous	-6.788889e-02
## Twigs/branches:shrubScrub-Other:grasslandHerbaceous	3.829167e-01
## Woody material:shrubScrub-Other:grasslandHerbaceous	3.130208e-02
## Twigs/branches:grasslandHerbaceous-Seeds:grasslandHerbaceous	9.444833e-01
## Woody material:grasslandHerbaceous-Seeds:grasslandHerbaceous	4.346088e-02

## Flowers:shrubScrub-Seeds:grasslandHerbaceous	1.008895e-02
## Leaves:shrubScrub-Seeds:grasslandHerbaceous	5.351950e-02
## Mixed:shrubScrub-Seeds:grasslandHerbaceous	2.260768e+00
## Needles:shrubScrub-Seeds:grasslandHerbaceous	4.400872e+00
## Other:shrubScrub-Seeds:grasslandHerbaceous	6.115942e-02
## Seeds:shrubScrub-Seeds:grasslandHerbaceous	2.336111e-02
## Twigs/branches:shrubScrub-Seeds:grasslandHerbaceous	4.741667e-01
## Woody material:shrubScrub-Seeds:grasslandHerbaceous	1.225521e-01
## Woody material:grasslandHerbaceous-Twigs/branches:grasslandHerbaceous	-9.010224e-01
## Flowers:shrubScrub-Twigs/branches:grasslandHerbaceous	-9.343944e-01
## Leaves:shrubScrub-Twigs/branches:grasslandHerbaceous	-8.909638e-01
## Mixed:shrubScrub-Twigs/branches:grasslandHerbaceous	1.316284e+00
## Needles:shrubScrub-Twigs/branches:grasslandHerbaceous	3.456389e+00
## Other:shrubScrub-Twigs/branches:grasslandHerbaceous	-8.833239e-01
## Seeds:shrubScrub-Twigs/branches:grasslandHerbaceous	-9.211222e-01
## Twigs/branches:shrubScrub-Twigs/branches:grasslandHerbaceous	-4.703167e-01
## Woody material:shrubScrub-Twigs/branches:grasslandHerbaceous	-8.219313e-01
## Flowers:shrubScrub-Woody material:grasslandHerbaceous	-3.337193e-02
## Leaves:shrubScrub-Woody material:grasslandHerbaceous	1.005862e-02
## Mixed:shrubScrub-Woody material:grasslandHerbaceous	2.217307e+00
## Needles:shrubScrub-Woody material:grasslandHerbaceous	4.357411e+00
## Other:shrubScrub-Woody material:grasslandHerbaceous	1.769854e-02
## Seeds:shrubScrub-Woody material:grasslandHerbaceous	-2.009977e-02
## Twigs/branches:shrubScrub-Woody material:grasslandHerbaceous	4.307058e-01
## Woody material:shrubScrub-Woody material:grasslandHerbaceous	7.909120e-02
## Leaves:shrubScrub-Flowers:shrubScrub	4.343055e-02
## Mixed:shrubScrub-Flowers:shrubScrub	2.250679e+00
## Needles:shrubScrub-Flowers:shrubScrub	4.390783e+00
## Other:shrubScrub-Flowers:shrubScrub	5.107047e-02
## Seeds:shrubScrub-Flowers:shrubScrub	1.327216e-02
## Twigs/branches:shrubScrub-Flowers:shrubScrub	4.640777e-01
## Woody material:shrubScrub-Flowers:shrubScrub	1.124631e-01
## Mixed:shrubScrub-Leaves:shrubScrub	2.207248e+00
## Needles:shrubScrub-Leaves:shrubScrub	4.347352e+00
## Other:shrubScrub-Leaves:shrubScrub	7.639917e-03
## Seeds:shrubScrub-Leaves:shrubScrub	-3.015839e-02
## Twigs/branches:shrubScrub-Leaves:shrubScrub	4.206472e-01
## Woody material:shrubScrub-Leaves:shrubScrub	6.903258e-02
## Needles:shrubScrub-Mixed:shrubScrub	2.140104e+00
## Other:shrubScrub-Mixed:shrubScrub	-2.199608e+00
## Seeds:shrubScrub-Mixed:shrubScrub	-2.237406e+00
## Twigs/branches:shrubScrub-Mixed:shrubScrub	-1.786601e+00
## Woody material:shrubScrub-Mixed:shrubScrub	-2.138215e+00
## Other:shrubScrub-Needles:shrubScrub	-4.339713e+00
## Seeds:shrubScrub-Needles:shrubScrub	-4.377511e+00
## Twigs/branches:shrubScrub-Needles:shrubScrub	-3.926705e+00
## Woody material:shrubScrub-Needles:shrubScrub	-4.278320e+00
## Seeds:shrubScrub-Other:shrubScrub	-3.779831e-02
## Twigs/branches:shrubScrub-Other:shrubScrub	4.130072e-01
## Woody material:shrubScrub-Other:shrubScrub	6.139266e-02
## Twigs/branches:shrubScrub-Seeds:shrubScrub	4.508056e-01
## Woody material:shrubScrub-Seeds:shrubScrub	9.919097e-02
## Woody material:shrubScrub-Twigs/branches:shrubScrub	-3.516146e-01
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## Leaves:evergreenForest-Flowers:evergreenForest	-2.129566790
## Mixed:evergreenForest-Flowers:evergreenForest	-0.819782291
## Needles:evergreenForest-Flowers:evergreenForest	5.355878443
## Other:evergreenForest-Flowers:evergreenForest	-2.060784739
## Seeds:evergreenForest-Flowers:evergreenForest	-2.072130893
## Twigs/branches:evergreenForest-Flowers:evergreenForest	-0.023609487
## Woody material:evergreenForest-Flowers:evergreenForest	-0.852386878
## Flowers:grasslandHerbaceous-Flowers:evergreenForest	-2.454136383
## Leaves:grasslandHerbaceous-Flowers:evergreenForest	-2.344114655
## Mixed:grasslandHerbaceous-Flowers:evergreenForest	-2.173621929
## Needles:grasslandHerbaceous-Flowers:evergreenForest	2.816896666
## Other:grasslandHerbaceous-Flowers:evergreenForest	-2.347490625
## Seeds:grasslandHerbaceous-Flowers:evergreenForest	-2.438740625
## Twigs/branches:grasslandHerbaceous-Flowers:evergreenForest	-1.465016727
## Woody material:grasslandHerbaceous-Flowers:evergreenForest	-2.380407340
## Flowers:shrubScrub-Flowers:evergreenForest	-2.065670211
## Leaves:shrubScrub-Flowers:evergreenForest	-1.997386878
## Mixed:shrubScrub-Flowers:evergreenForest	-0.361861760
## Needles:shrubScrub-Flowers:evergreenForest	2.363784540
## Other:shrubScrub-Flowers:evergreenForest	-1.999401547
## Seeds:shrubScrub-Flowers:evergreenForest	-2.047232668
## Twigs/branches:shrubScrub-Flowers:evergreenForest	-1.567442022
## Woody material:shrubScrub-Flowers:evergreenForest	-1.919056606
## Mixed:evergreenForest-Leaves:evergreenForest	-0.727331832
## Needles:evergreenForest-Leaves:evergreenForest	5.446243927
## Other:evergreenForest-Leaves:evergreenForest	-1.969967636
## Seeds:evergreenForest-Leaves:evergreenForest	-1.981313790
## Twigs/branches:evergreenForest-Leaves:evergreenForest	0.066934267
## Woody material:evergreenForest-Leaves:evergreenForest	-0.762155004
## Flowers:grasslandHerbaceous-Leaves:evergreenForest	-2.361612874
## Leaves:grasslandHerbaceous-Leaves:evergreenForest	-2.252006448
## Mixed:grasslandHerbaceous-Leaves:evergreenForest	-2.078173664
## Needles:grasslandHerbaceous-Leaves:evergreenForest	2.908940663
## Other:grasslandHerbaceous-Leaves:evergreenForest	-2.255040166
## Seeds:grasslandHerbaceous-Leaves:evergreenForest	-2.346290166
## Twigs/branches:grasslandHerbaceous-Leaves:evergreenForest	-1.372707607
## Woody material:grasslandHerbaceous-Leaves:evergreenForest	-2.288028325
## Flowers:shrubScrub-Leaves:evergreenForest	-1.975270111
## Leaves:shrubScrub-Leaves:evergreenForest	-1.907155004
## Mixed:shrubScrub-Leaves:evergreenForest	-0.268597476
## Needles:shrubScrub-Leaves:evergreenForest	2.453921013
## Other:shrubScrub-Leaves:evergreenForest	-1.909103817
## Seeds:shrubScrub-Leaves:evergreenForest	-1.956867184
## Twigs/branches:shrubScrub-Leaves:evergreenForest	-1.477274187
## Woody material:shrubScrub-Leaves:evergreenForest	-1.828888771
## Needles:evergreenForest-Mixed:evergreenForest	3.531924601
## Other:evergreenForest-Mixed:evergreenForest	-3.875248499
## Seeds:evergreenForest-Mixed:evergreenForest	-3.886594653
## Twigs/branches:evergreenForest-Mixed:evergreenForest	-1.843831981
## Woody material:evergreenForest-Mixed:evergreenForest	-2.679124714
## Flowers:grasslandHerbaceous-Mixed:evergreenForest	-4.231642975
## Leaves:grasslandHerbaceous-Mixed:evergreenForest	-4.130774071
## Mixed:grasslandHerbaceous-Mixed:evergreenForest	-3.883933992
## Needles:grasslandHerbaceous-Mixed:evergreenForest	1.028831138

## Other:grasslandHerbaceous-Mixed:evergreenForest	-4.126614443
## Seeds:grasslandHerbaceous-Mixed:evergreenForest	-4.217864443
## Twigs/branches:grasslandHerbaceous-Mixed:evergreenForest	-3.247260787
## Woody material:grasslandHerbaceous-Mixed:evergreenForest	-4.161109834
## Flowers:shrubScrub-Mixed:evergreenForest	-3.888901015
## Leaves:shrubScrub-Mixed:evergreenForest	-3.824124714
## Mixed:shrubScrub-Mixed:evergreenForest	-2.122795347
## Needles:shrubScrub-Mixed:evergreenForest	0.535065489
## Other:shrubScrub-Mixed:evergreenForest	-3.824768514
## Seeds:shrubScrub-Mixed:evergreenForest	-3.871186510
## Twigs/branches:shrubScrub-Mixed:evergreenForest	-3.395510380
## Woody material:shrubScrub-Mixed:evergreenForest	-3.747124963
## Other:evergreenForest-Needles:evergreenForest	-9.316700517
## Seeds:evergreenForest-Needles:evergreenForest	-9.328046671
## Twigs/branches:evergreenForest-Needles:evergreenForest	-7.278276535
## Woody material:evergreenForest-Needles:evergreenForest	-8.105625630
## Flowers:grasslandHerbaceous-Needles:evergreenForest	-9.717786337
## Leaves:grasslandHerbaceous-Needles:evergreenForest	-9.605891491
## Mixed:grasslandHerbaceous-Needles:evergreenForest	-9.450320490
## Needles:grasslandHerbaceous-Needles:evergreenForest	-4.444590062
## Other:grasslandHerbaceous-Needles:evergreenForest	-9.610811510
## Seeds:grasslandHerbaceous-Needles:evergreenForest	-9.702061510
## Twigs/branches:grasslandHerbaceous-Needles:evergreenForest	-8.727700435
## Woody material:grasslandHerbaceous-Needles:evergreenForest	-9.643406225
## Flowers:shrubScrub-Needles:evergreenForest	-9.319679856
## Leaves:shrubScrub-Needles:evergreenForest	-9.250625630
## Mixed:shrubScrub-Needles:evergreenForest	-7.628839266
## Needles:shrubScrub-Needles:evergreenForest	-4.889016539
## Other:shrubScrub-Needles:evergreenForest	-9.252942218
## Seeds:shrubScrub-Needles:evergreenForest	-9.301083779
## Twigs/branches:shrubScrub-Needles:evergreenForest	-8.820387022
## Woody material:shrubScrub-Needles:evergreenForest	-9.172001606
## Seeds:evergreenForest-Other:evergreenForest	-2.050095841
## Twigs/branches:evergreenForest-Other:evergreenForest	-0.001847784
## Woody material:evergreenForest-Other:evergreenForest	-0.830937055
## Flowers:grasslandHerbaceous-Other:evergreenForest	-2.430394925
## Leaves:grasslandHerbaceous-Other:evergreenForest	-2.320788499
## Mixed:grasslandHerbaceous-Other:evergreenForest	-2.146955715
## Needles:grasslandHerbaceous-Other:evergreenForest	2.840158612
## Other:grasslandHerbaceous-Other:evergreenForest	-2.323822217
## Seeds:grasslandHerbaceous-Other:evergreenForest	-2.415072217
## Twigs/branches:grasslandHerbaceous-Other:evergreenForest	-1.441489659
## Woody material:grasslandHerbaceous-Other:evergreenForest	-2.356810376
## Flowers:shrubScrub-Other:evergreenForest	-2.044052162
## Leaves:shrubScrub-Other:evergreenForest	-1.975937055
## Mixed:shrubScrub-Other:evergreenForest	-0.337379527
## Needles:shrubScrub-Other:evergreenForest	2.385138962
## Other:shrubScrub-Other:evergreenForest	-1.977885868
## Seeds:shrubScrub-Other:evergreenForest	-2.025649235
## Twigs/branches:shrubScrub-Other:evergreenForest	-1.546056239
## Woody material:shrubScrub-Other:evergreenForest	-1.897670822
## Twigs/branches:evergreenForest-Seeds:evergreenForest	0.009498370
## Woody material:evergreenForest-Seeds:evergreenForest	-0.819590901
## Flowers:grasslandHerbaceous-Seeds:evergreenForest	-2.419048771

## Leaves:grasslandHerbaceous-Seeds:evergreenForest	-2.309442346
## Mixed:grasslandHerbaceous-Seeds:evergreenForest	-2.135609561
## Needles:grasslandHerbaceous-Seeds:evergreenForest	2.851504766
## Other:grasslandHerbaceous-Seeds:evergreenForest	-2.312476063
## Seeds:grasslandHerbaceous-Seeds:evergreenForest	-2.403726063
## Twigs/branches:grasslandHerbaceous-Seeds:evergreenForest	-1.430143505
## Woody material:grasslandHerbaceous-Seeds:evergreenForest	-2.345464223
## Flowers:shrubScrub-Seeds:evergreenForest	-2.032706008
## Leaves:shrubScrub-Seeds:evergreenForest	-1.964590901
## Mixed:shrubScrub-Seeds:evergreenForest	-0.326033374
## Needles:shrubScrub-Seeds:evergreenForest	2.396485116
## Other:shrubScrub-Seeds:evergreenForest	-1.966539715
## Seeds:shrubScrub-Seeds:evergreenForest	-2.014303081
## Twigs/branches:shrubScrub-Seeds:evergreenForest	-1.534710085
## Woody material:shrubScrub-Seeds:evergreenForest	-1.886324668
## Woody material:evergreenForest-Twigs/branches:evergreenForest	-2.781035142
## Flowers:grasslandHerbaceous-Twigs/branches:evergreenForest	-4.388195920
## Leaves:grasslandHerbaceous-Twigs/branches:evergreenForest	-4.277197825
## Mixed:grasslandHerbaceous-Twigs/branches:evergreenForest	-4.114512140
## Needles:grasslandHerbaceous-Twigs/branches:evergreenForest	0.883964611
## Other:grasslandHerbaceous-Twigs/branches:evergreenForest	-4.281378550
## Seeds:grasslandHerbaceous-Twigs/branches:evergreenForest	-4.372628550
## Twigs/branches:grasslandHerbaceous-Twigs/branches:evergreenForest	-3.398572461
## Woody material:grasslandHerbaceous-Twigs/branches:evergreenForest	-4.314127375
## Flowers:shrubScrub-Twigs/branches:evergreenForest	-3.994717783
## Leaves:shrubScrub-Twigs/branches:evergreenForest	-3.926035142
## Mixed:shrubScrub-Twigs/branches:evergreenForest	-2.297658559
## Needles:shrubScrub-Twigs/branches:evergreenForest	0.435362879
## Other:shrubScrub-Twigs/branches:evergreenForest	-3.928206172
## Seeds:shrubScrub-Twigs/branches:evergreenForest	-3.976198104
## Twigs/branches:shrubScrub-Twigs/branches:evergreenForest	-3.495938190
## Woody material:shrubScrub-Twigs/branches:evergreenForest	-3.847552773
## Flowers:grasslandHerbaceous-Woody material:evergreenForest	-3.473047144
## Leaves:grasslandHerbaceous-Woody material:evergreenForest	-3.360485792
## Mixed:grasslandHerbaceous-Woody material:evergreenForest	-3.210168378
## Needles:grasslandHerbaceous-Woody material:evergreenForest	1.800919068
## Other:grasslandHerbaceous-Woody material:evergreenForest	-3.365955387
## Seeds:grasslandHerbaceous-Woody material:evergreenForest	-3.457205387
## Twigs/branches:grasslandHerbaceous-Woody material:evergreenForest	-2.482617706
## Woody material:grasslandHerbaceous-Woody material:evergreenForest	-3.398435618
## Flowers:shrubScrub-Woody material:evergreenForest	-3.071484775
## Leaves:shrubScrub-Woody material:evergreenForest	-3.002151280
## Mixed:shrubScrub-Woody material:evergreenForest	-1.385278734
## Needles:shrubScrub-Woody material:evergreenForest	1.359616573
## Other:shrubScrub-Woody material:evergreenForest	-3.004577298
## Seeds:shrubScrub-Woody material:evergreenForest	-3.052831304
## Twigs/branches:shrubScrub-Woody material:evergreenForest	-2.571806133
## Woody material:shrubScrub-Woody material:evergreenForest	-2.923420716
## Leaves:grasslandHerbaceous-Flowers:grasslandHerbaceous	-2.525947305
## Mixed:grasslandHerbaceous-Flowers:grasslandHerbaceous	-2.275570489
## Needles:grasslandHerbaceous-Flowers:grasslandHerbaceous	2.633595693
## Other:grasslandHerbaceous-Flowers:grasslandHerbaceous	-2.521452372
## Seeds:grasslandHerbaceous-Flowers:grasslandHerbaceous	-2.612702372
## Twigs/branches:grasslandHerbaceous-Flowers:grasslandHerbaceous	-1.642237944

## Woody material:grasslandHerbaceous-Flowers:grasslandHerbaceous	-2.556018273
## Flowers:shrubScrub-Flowers:grasslandHerbaceous	-2.285654795
## Leaves:shrubScrub-Flowers:grasslandHerbaceous	-2.221025867
## Mixed:shrubScrub-Flowers:grasslandHerbaceous	-0.516810898
## Needles:shrubScrub-Flowers:grasslandHerbaceous	2.138081412
## Other:shrubScrub-Flowers:grasslandHerbaceous	-2.221612149
## Seeds:shrubScrub-Flowers:grasslandHerbaceous	-2.267970735
## Twigs/branches:shrubScrub-Flowers:grasslandHerbaceous	-1.792467249
## Woody material:shrubScrub-Flowers:grasslandHerbaceous	-2.144081832
## Mixed:grasslandHerbaceous-Leaves:grasslandHerbaceous	-2.242688898
## Needles:grasslandHerbaceous-Leaves:grasslandHerbaceous	2.686614256
## Other:grasslandHerbaceous-Leaves:grasslandHerbaceous	-2.470675800
## Seeds:grasslandHerbaceous-Leaves:grasslandHerbaceous	-2.561925800
## Twigs/branches:grasslandHerbaceous-Leaves:grasslandHerbaceous	-1.590676684
## Woody material:grasslandHerbaceous-Leaves:grasslandHerbaceous	-2.504844380
## Flowers:shrubScrub-Leaves:grasslandHerbaceous	-2.224025740
## Leaves:shrubScrub-Leaves:grasslandHerbaceous	-2.158556848
## Mixed:shrubScrub-Leaves:grasslandHerbaceous	-0.470657508
## Needles:shrubScrub-Leaves:grasslandHerbaceous	2.201023401
## Other:shrubScrub-Leaves:grasslandHerbaceous	-2.159471049
## Seeds:shrubScrub-Leaves:grasslandHerbaceous	-2.206168220
## Twigs/branches:shrubScrub-Leaves:grasslandHerbaceous	-1.729680474
## Woody material:shrubScrub-Leaves:grasslandHerbaceous	-2.081295058
## Needles:grasslandHerbaceous-Mixed:grasslandHerbaceous	0.717158412
## Other:grasslandHerbaceous-Mixed:grasslandHerbaceous	-4.420892325
## Seeds:grasslandHerbaceous-Mixed:grasslandHerbaceous	-4.512142325
## Twigs/branches:grasslandHerbaceous-Mixed:grasslandHerbaceous	-3.547667319
## Woody material:grasslandHerbaceous-Mixed:grasslandHerbaceous	-4.458496390
## Flowers:shrubScrub-Mixed:grasslandHerbaceous	-4.264139288
## Leaves:shrubScrub-Mixed:grasslandHerbaceous	-4.205296038
## Mixed:shrubScrub-Mixed:grasslandHerbaceous	-2.380067193
## Needles:shrubScrub-Mixed:grasslandHerbaceous	0.150573806
## Other:shrubScrub-Mixed:grasslandHerbaceous	-4.203629135
## Seeds:shrubScrub-Mixed:grasslandHerbaceous	-4.247653823
## Twigs/branches:shrubScrub-Mixed:grasslandHerbaceous	-3.778914039
## Woody material:shrubScrub-Mixed:grasslandHerbaceous	-4.130528622
## Other:grasslandHerbaceous-Needles:grasslandHerbaceous	-7.607904973
## Seeds:grasslandHerbaceous-Needles:grasslandHerbaceous	-7.699154973
## Twigs/branches:grasslandHerbaceous-Needles:grasslandHerbaceous	-6.727786019
## Woody material:grasslandHerbaceous-Needles:grasslandHerbaceous	-7.642012890
## Flowers:shrubScrub-Needles:grasslandHerbaceous	-7.359585593
## Leaves:shrubScrub-Needles:grasslandHerbaceous	-7.293986369
## Mixed:shrubScrub-Needles:grasslandHerbaceous	-5.608590200
## Needles:shrubScrub-Needles:grasslandHerbaceous	-2.934332658
## Other:shrubScrub-Needles:grasslandHerbaceous	-7.294951471
## Seeds:shrubScrub-Needles:grasslandHerbaceous	-7.341701173
## Twigs/branches:shrubScrub-Needles:grasslandHerbaceous	-6.865060647
## Woody material:shrubScrub-Needles:grasslandHerbaceous	-7.216675230
## Seeds:grasslandHerbaceous-Other:grasslandHerbaceous	-2.690156110
## Twigs/branches:grasslandHerbaceous-Other:grasslandHerbaceous	-1.719552454
## Woody material:grasslandHerbaceous-Other:grasslandHerbaceous	-2.633401501
## Flowers:shrubScrub-Other:grasslandHerbaceous	-2.361192682
## Leaves:shrubScrub-Other:grasslandHerbaceous	-2.296416380
## Mixed:shrubScrub-Other:grasslandHerbaceous	-0.595087013



## Needles:shrubScrub-Other:grasslandHerbaceous	2.062773823
## Other:shrubScrub-Other:grasslandHerbaceous	-2.297060180
## Seeds:shrubScrub-Other:grasslandHerbaceous	-2.343478177
## Twigs/branches:shrubScrub-Other:grasslandHerbaceous	-1.867802046
## Woody material:shrubScrub-Other:grasslandHerbaceous	-2.219416630
## Twigs/branches:grasslandHerbaceous-Seeds:grasslandHerbaceous	-1.628302454
## Woody material:grasslandHerbaceous-Seeds:grasslandHerbaceous	-2.542151501
## Flowers:shrubScrub-Seeds:grasslandHerbaceous	-2.269942682
## Leaves:shrubScrub-Seeds:grasslandHerbaceous	-2.205166380
## Mixed:shrubScrub-Seeds:grasslandHerbaceous	-0.503837013
## Needles:shrubScrub-Seeds:grasslandHerbaceous	2.154023823
## Other:shrubScrub-Seeds:grasslandHerbaceous	-2.205810180
## Seeds:shrubScrub-Seeds:grasslandHerbaceous	-2.252228177
## Twigs/branches:shrubScrub-Seeds:grasslandHerbaceous	-1.776552046
## Woody material:shrubScrub-Seeds:grasslandHerbaceous	-2.128166630
## Woody material:grasslandHerbaceous-Twigs/branches:grasslandHerbaceous	-3.460378842
## Flowers:shrubScrub-Twigs/branches:grasslandHerbaceous	-3.184607259
## Leaves:shrubScrub-Twigs/branches:grasslandHerbaceous	-3.119545366
## Mixed:shrubScrub-Twigs/branches:grasslandHerbaceous	-1.423780040
## Needles:shrubScrub-Twigs/branches:grasslandHerbaceous	1.239805604
## Other:shrubScrub-Twigs/branches:grasslandHerbaceous	-3.120300648
## Seeds:shrubScrub-Twigs/branches:grasslandHerbaceous	-3.166833768
## Twigs/branches:shrubScrub-Twigs/branches:grasslandHerbaceous	-2.690823020
## Woody material:shrubScrub-Twigs/branches:grasslandHerbaceous	-3.042437603
## Flowers:shrubScrub-Woody material:grasslandHerbaceous	-2.298238969
## Leaves:shrubScrub-Woody material:grasslandHerbaceous	-2.233318380
## Mixed:shrubScrub-Woody material:grasslandHerbaceous	-0.534804675
## Needles:shrubScrub-Woody material:grasslandHerbaceous	2.125953034
## Other:shrubScrub-Woody material:grasslandHerbaceous	-2.234018500
## Seeds:shrubScrub-Woody material:grasslandHerbaceous	-2.280494661
## Twigs/branches:shrubScrub-Woody material:grasslandHerbaceous	-1.804649483
## Woody material:shrubScrub-Woody material:grasslandHerbaceous	-2.156264067
## Leaves:shrubScrub-Flowers:shrubScrub	-1.839623670
## Mixed:shrubScrub-Flowers:shrubScrub	-0.216560682
## Needles:shrubScrub-Flowers:shrubScrub	2.521944369
## Other:shrubScrub-Flowers:shrubScrub	-1.841911954
## Seeds:shrubScrub-Flowers:shrubScrub	-1.890024425
## Twigs/branches:shrubScrub-Flowers:shrubScrub	-1.409412612
## Woody material:shrubScrub-Flowers:shrubScrub	-1.761027196
## Mixed:shrubScrub-Leaves:shrubScrub	-0.240278734
## Needles:shrubScrub-Leaves:shrubScrub	2.504616573
## Other:shrubScrub-Leaves:shrubScrub	-1.859577298
## Seeds:shrubScrub-Leaves:shrubScrub	-1.907831304
## Twigs/branches:shrubScrub-Leaves:shrubScrub	-1.426806133
## Woody material:shrubScrub-Leaves:shrubScrub	-1.778420716
## Needles:shrubScrub-Mixed:shrubScrub	-0.296502226
## Other:shrubScrub-Mixed:shrubScrub	-4.654781551
## Seeds:shrubScrub-Mixed:shrubScrub	-4.700541021
## Twigs/branches:shrubScrub-Mixed:shrubScrub	-4.226777124
## Woody material:shrubScrub-Mixed:shrubScrub	-4.578391707
## Other:shrubScrub-Needles:shrubScrub	-6.192592738
## Seeds:shrubScrub-Needles:shrubScrub	-6.240927192
## Twigs/branches:shrubScrub-Needles:shrubScrub	-5.759666990
## Woody material:shrubScrub-Needles:shrubScrub	-6.111281573

## Seeds:shrubScrub-Other:shrubScrub	-1.925427725
## Twigs/branches:shrubScrub-Other:shrubScrub	-1.444564537
## Woody material:shrubScrub-Other:shrubScrub	-1.796179120
## Twigs/branches:shrubScrub-Seeds:shrubScrub	-1.417275911
## Woody material:shrubScrub-Seeds:shrubScrub	-1.768890494
## Woody material:shrubScrub-Twigs/branches:shrubScrub	-2.189318717
##	upr
## Leaves:evergreenForest-Flowers:evergreenForest	1.92236807
## Mixed:evergreenForest-Flowers:evergreenForest	3.82928229
## Needles:evergreenForest-Flowers:evergreenForest	9.26864934
## Other:evergreenForest-Flowers:evergreenForest	1.99115012
## Seeds:evergreenForest-Flowers:evergreenForest	1.97980397
## Twigs/branches:evergreenForest-Flowers:evergreenForest	3.94294772
## Woody material:evergreenForest-Flowers:evergreenForest	3.02100922
## Flowers:grasslandHerbaceous-Flowers:evergreenForest	2.22573745
## Leaves:grasslandHerbaceous-Flowers:evergreenForest	2.16580805
## Mixed:grasslandHerbaceous-Flowers:evergreenForest	4.19237193
## Needles:grasslandHerbaceous-Flowers:evergreenForest	7.30163111
## Other:grasslandHerbaceous-Flowers:evergreenForest	2.30157396
## Seeds:grasslandHerbaceous-Flowers:evergreenForest	2.21032396
## Twigs/branches:grasslandHerbaceous-Flowers:evergreenForest	3.12556673
## Woody material:grasslandHerbaceous-Flowers:evergreenForest	2.23891244
## Flowers:shrubScrub-Flowers:evergreenForest	1.85743145
## Leaves:shrubScrub-Flowers:evergreenForest	1.87600922
## Mixed:shrubScrub-Flowers:evergreenForest	4.65498018
## Needles:shrubScrub-Flowers:evergreenForest	6.20954278
## Other:shrubScrub-Flowers:evergreenForest	1.89330372
## Seeds:shrubScrub-Flowers:evergreenForest	1.86553822
## Twigs/branches:shrubScrub-Flowers:evergreenForest	2.28735869
## Woody material:shrubScrub-Flowers:evergreenForest	1.93574411
## Mixed:evergreenForest-Leaves:evergreenForest	3.94403055
## Needles:evergreenForest-Leaves:evergreenForest	9.38548257
## Other:evergreenForest-Leaves:evergreenForest	2.10753174
## Seeds:evergreenForest-Leaves:evergreenForest	2.09618558
## Twigs/branches:evergreenForest-Leaves:evergreenForest	4.05960269
## Woody material:evergreenForest-Leaves:evergreenForest	3.13797606
## Flowers:grasslandHerbaceous-Leaves:evergreenForest	2.34041266
## Leaves:grasslandHerbaceous-Leaves:evergreenForest	2.28089856
## Mixed:grasslandHerbaceous-Leaves:evergreenForest	4.30412238
## Needles:grasslandHerbaceous-Leaves:evergreenForest	7.41678583
## Other:grasslandHerbaceous-Leaves:evergreenForest	2.41632222
## Seeds:grasslandHerbaceous-Leaves:evergreenForest	2.32507222
## Twigs/branches:grasslandHerbaceous-Leaves:evergreenForest	3.24045633
## Woody material:grasslandHerbaceous-Leaves:evergreenForest	2.35373215
## Flowers:shrubScrub-Leaves:evergreenForest	1.97423006
## Leaves:shrubScrub-Leaves:evergreenForest	1.99297606
## Mixed:shrubScrub-Leaves:evergreenForest	4.76891462
## Needles:shrubScrub-Leaves:evergreenForest	6.32660502
## Other:shrubScrub-Leaves:evergreenForest	2.01020471
## Seeds:shrubScrub-Leaves:evergreenForest	1.98237146
## Twigs/branches:shrubScrub-Leaves:evergreenForest	2.40438957
## Woody material:shrubScrub-Leaves:evergreenForest	2.05277499
## Needles:evergreenForest-Mixed:evergreenForest	8.08310318
## Other:evergreenForest-Mixed:evergreenForest	0.79611388

## Seeds:evergreenForest-Mixed:evergreenForest	0.78476773
## Twigs/branches:evergreenForest-Mixed:evergreenForest	2.75367022
## Woody material:evergreenForest-Mixed:evergreenForest	1.83824705
## Flowers:grasslandHerbaceous-Mixed:evergreenForest	0.99374404
## Leaves:grasslandHerbaceous-Mixed:evergreenForest	0.94296747
## Mixed:grasslandHerbaceous-Mixed:evergreenForest	2.89318399
## Needles:grasslandHerbaceous-Mixed:evergreenForest	6.08019664
## Other:grasslandHerbaceous-Mixed:evergreenForest	1.07119778
## Seeds:grasslandHerbaceous-Mixed:evergreenForest	0.97994778
## Twigs/branches:grasslandHerbaceous-Mixed:evergreenForest	1.89831079
## Woody material:grasslandHerbaceous-Mixed:evergreenForest	1.01011494
## Flowers:shrubScrub-Mixed:evergreenForest	0.67116225
## Leaves:shrubScrub-Mixed:evergreenForest	0.69324705
## Mixed:shrubScrub-Mixed:evergreenForest	3.40641377
## Needles:shrubScrub-Mixed:evergreenForest	5.02876183
## Other:shrubScrub-Mixed:evergreenForest	0.70917069
## Seeds:shrubScrub-Mixed:evergreenForest	0.67999207
## Twigs/branches:shrubScrub-Mixed:evergreenForest	1.10592705
## Woody material:shrubScrub-Mixed:evergreenForest	0.75431246
## Other:evergreenForest-Needles:evergreenForest	-5.37746188
## Seeds:evergreenForest-Needles:evergreenForest	-5.38880803
## Twigs/branches:evergreenForest-Needles:evergreenForest	-3.42691301
## Woody material:evergreenForest-Needles:evergreenForest	-4.35027981
## Flowers:grasslandHerbaceous-Needles:evergreenForest	-5.13514038
## Leaves:grasslandHerbaceous-Needles:evergreenForest	-5.19694289
## Mixed:grasslandHerbaceous-Needles:evergreenForest	-3.15545729
## Needles:grasslandHerbaceous-Needles:evergreenForest	-0.06140994
## Other:grasslandHerbaceous-Needles:evergreenForest	-5.05963293
## Seeds:grasslandHerbaceous-Needles:evergreenForest	-5.15088293
## Twigs/branches:grasslandHerbaceous-Needles:evergreenForest	-4.23627734
## Woody material:grasslandHerbaceous-Needles:evergreenForest	-5.12261645
## Flowers:shrubScrub-Needles:evergreenForest	-5.51308669
## Leaves:shrubScrub-Needles:evergreenForest	-5.49527981
## Mixed:shrubScrub-Needles:evergreenForest	-2.70257009
## Needles:shrubScrub-Needles:evergreenForest	-1.16218392
## Other:shrubScrub-Needles:evergreenForest	-5.47768339
## Seeds:shrubScrub-Needles:evergreenForest	-5.50513844
## Twigs/branches:shrubScrub-Needles:evergreenForest	-5.08422409
## Woody material:shrubScrub-Needles:evergreenForest	-5.43583867
## Seeds:evergreenForest-Other:evergreenForest	2.02740353
## Twigs/branches:evergreenForest-Other:evergreenForest	3.99082063
## Woody material:evergreenForest-Other:evergreenForest	3.06919401
## Flowers:grasslandHerbaceous-Other:evergreenForest	2.27163060
## Leaves:grasslandHerbaceous-Other:evergreenForest	2.21211651
## Mixed:grasslandHerbaceous-Other:evergreenForest	4.23534033
## Needles:grasslandHerbaceous-Other:evergreenForest	7.34800378
## Other:grasslandHerbaceous-Other:evergreenForest	2.34754017
## Seeds:grasslandHerbaceous-Other:evergreenForest	2.25629017
## Twigs/branches:grasslandHerbaceous-Other:evergreenForest	3.17167427
## Woody material:grasslandHerbaceous-Other:evergreenForest	2.28495009
## Flowers:shrubScrub-Other:evergreenForest	1.90544801
## Leaves:shrubScrub-Other:evergreenForest	1.92419401
## Mixed:shrubScrub-Other:evergreenForest	4.70013256
## Needles:shrubScrub-Other:evergreenForest	6.25782297

## Other:shrubScrub-Other:evergreenForest	1.94142266
## Seeds:shrubScrub-Other:evergreenForest	1.91358941
## Twigs/branches:shrubScrub-Other:evergreenForest	2.33560752
## Woody material:shrubScrub-Other:evergreenForest	1.98399294
## Twigs/branches:evergreenForest-Seeds:evergreenForest	4.00216679
## Woody material:evergreenForest-Seeds:evergreenForest	3.08054016
## Flowers:grasslandHerbaceous-Seeds:evergreenForest	2.28297676
## Leaves:grasslandHerbaceous-Seeds:evergreenForest	2.22346266
## Mixed:grasslandHerbaceous-Seeds:evergreenForest	4.24668648
## Needles:grasslandHerbaceous-Seeds:evergreenForest	7.35934994
## Other:grasslandHerbaceous-Seeds:evergreenForest	2.35888632
## Seeds:grasslandHerbaceous-Seeds:evergreenForest	2.26763632
## Twigs/branches:grasslandHerbaceous-Seeds:evergreenForest	3.18302043
## Woody material:grasslandHerbaceous-Seeds:evergreenForest	2.29629625
## Flowers:shrubScrub-Seeds:evergreenForest	1.91679417
## Leaves:shrubScrub-Seeds:evergreenForest	1.93554016
## Mixed:shrubScrub-Seeds:evergreenForest	4.71147872
## Needles:shrubScrub-Seeds:evergreenForest	6.26916913
## Other:shrubScrub-Seeds:evergreenForest	1.95276881
## Seeds:shrubScrub-Seeds:evergreenForest	1.92493556
## Twigs/branches:shrubScrub-Seeds:evergreenForest	2.34695367
## Woody material:shrubScrub-Seeds:evergreenForest	1.99533909
## Woody material:evergreenForest-Twigs/branches:evergreenForest	1.03031925
## Flowers:grasslandHerbaceous-Twigs/branches:evergreenForest	0.24045875
## Leaves:grasslandHerbaceous-Twigs/branches:evergreenForest	0.17955299
## Mixed:grasslandHerbaceous-Twigs/branches:evergreenForest	2.21392390
## Needles:grasslandHerbaceous-Twigs/branches:evergreenForest	5.31522493
## Other:grasslandHerbaceous-Twigs/branches:evergreenForest	0.31612365
## Seeds:grasslandHerbaceous-Twigs/branches:evergreenForest	0.22487365
## Twigs/branches:grasslandHerbaceous-Twigs/branches:evergreenForest	1.13978423
## Woody material:grasslandHerbaceous-Twigs/branches:evergreenForest	0.25329424
## Flowers:shrubScrub-Twigs/branches:evergreenForest	-0.13285922
## Leaves:shrubScrub-Twigs/branches:evergreenForest	-0.11468075
## Mixed:shrubScrub-Twigs/branches:evergreenForest	2.67143875
## Needles:shrubScrub-Twigs/branches:evergreenForest	4.21862621
## Other:shrubScrub-Twigs/branches:evergreenForest	-0.09722989
## Seeds:shrubScrub-Twigs/branches:evergreenForest	-0.12483458
## Twigs/branches:shrubScrub-Twigs/branches:evergreenForest	0.29651662
## Woody material:shrubScrub-Twigs/branches:evergreenForest	-0.05509796
## Flowers:grasslandHerbaceous-Woody material:evergreenForest	1.07602587
## Leaves:grasslandHerbaceous-Woody material:evergreenForest	1.01355685
## Mixed:grasslandHerbaceous-Woody material:evergreenForest	3.06029604
## Needles:grasslandHerbaceous-Woody material:evergreenForest	6.14898637
## Other:grasslandHerbaceous-Woody material:evergreenForest	1.15141638
## Seeds:grasslandHerbaceous-Woody material:evergreenForest	1.06016638
## Twigs/branches:grasslandHerbaceous-Woody material:evergreenForest	1.97454537
## Woody material:grasslandHerbaceous-Woody material:evergreenForest	1.08831838
## Flowers:shrubScrub-Woody material:evergreenForest	0.69462367
## Leaves:shrubScrub-Woody material:evergreenForest	0.71215128
## Mixed:shrubScrub-Woody material:evergreenForest	3.50977481
## Needles:shrubScrub-Woody material:evergreenForest	5.04508841
## Other:shrubScrub-Woody material:evergreenForest	0.72985713
## Seeds:shrubScrub-Woody material:evergreenForest	0.70251452
## Twigs/branches:shrubScrub-Woody material:evergreenForest	1.12310046

## Woody material:shrubScrub-Woody material:evergreenForest	0.77148588
## Leaves:grasslandHerbaceous-Flowers:grasslandHerbaceous	2.57603964
## Mixed:grasslandHerbaceous-Flowers:grasslandHerbaceous	4.52271942
## Needles:grasslandHerbaceous-Flowers:grasslandHerbaceous	7.71333102
## Other:grasslandHerbaceous-Flowers:grasslandHerbaceous	2.70393464
## Seeds:grasslandHerbaceous-Flowers:grasslandHerbaceous	2.61268464
## Twigs/branches:grasslandHerbaceous-Flowers:grasslandHerbaceous	3.53118688
## Woody material:grasslandHerbaceous-Flowers:grasslandHerbaceous	2.64292231
## Flowers:shrubScrub-Flowers:grasslandHerbaceous	2.30581497
## Leaves:shrubScrub-Flowers:grasslandHerbaceous	2.32804714
## Mixed:shrubScrub-Flowers:grasslandHerbaceous	5.03832825
## Needles:shrubScrub-Flowers:grasslandHerbaceous	6.66364484
## Other:shrubScrub-Flowers:grasslandHerbaceous	2.34391326
## Seeds:shrubScrub-Flowers:grasslandHerbaceous	2.31467523
## Twigs/branches:shrubScrub-Flowers:grasslandHerbaceous	2.74078285
## Woody material:shrubScrub-Flowers:grasslandHerbaceous	2.38916827
## Mixed:grasslandHerbaceous-Leaves:grasslandHerbaceous	4.43974550
## Needles:grasslandHerbaceous-Leaves:grasslandHerbaceous	7.61022013
## Other:grasslandHerbaceous-Leaves:grasslandHerbaceous	2.60306574
## Seeds:grasslandHerbaceous-Leaves:grasslandHerbaceous	2.51181574
## Twigs/branches:grasslandHerbaceous-Leaves:grasslandHerbaceous	3.42953329
## Woody material:grasslandHerbaceous-Leaves:grasslandHerbaceous	2.54165609
## Flowers:shrubScrub-Leaves:grasslandHerbaceous	2.19409358
## Leaves:shrubScrub-Leaves:grasslandHerbaceous	2.21548579
## Mixed:shrubScrub-Leaves:grasslandHerbaceous	4.94208253
## Needles:shrubScrub-Leaves:grasslandHerbaceous	6.55061052
## Other:shrubScrub-Leaves:grasslandHerbaceous	2.23167983
## Seeds:shrubScrub-Leaves:grasslandHerbaceous	2.20278038
## Twigs/branches:shrubScrub-Leaves:grasslandHerbaceous	2.62790374
## Woody material:shrubScrub-Leaves:grasslandHerbaceous	2.27628916
## Needles:grasslandHerbaceous-Mixed:grasslandHerbaceous	7.38261937
## Other:grasslandHerbaceous-Mixed:grasslandHerbaceous	2.35622566
## Seeds:grasslandHerbaceous-Mixed:grasslandHerbaceous	2.26497566
## Twigs/branches:grasslandHerbaceous-Mixed:grasslandHerbaceous	3.18946732
## Woody material:grasslandHerbaceous-Mixed:grasslandHerbaceous	2.29825149
## Flowers:shrubScrub-Mixed:grasslandHerbaceous	2.03715052
## Leaves:shrubScrub-Mixed:grasslandHerbaceous	2.06516838
## Mixed:shrubScrub-Mixed:grasslandHerbaceous	4.65443561
## Needles:shrubScrub-Mixed:grasslandHerbaceous	6.40400351
## Other:shrubScrub-Mixed:grasslandHerbaceous	2.07878131
## Seeds:shrubScrub-Mixed:grasslandHerbaceous	2.04720938
## Twigs/branches:shrubScrub-Mixed:grasslandHerbaceous	2.48008071
## Woody material:shrubScrub-Mixed:grasslandHerbaceous	2.12846612
## Other:grasslandHerbaceous-Needles:grasslandHerbaceous	-2.55653947
## Seeds:grasslandHerbaceous-Needles:grasslandHerbaceous	-2.64778947
## Twigs/branches:grasslandHerbaceous-Needles:grasslandHerbaceous	-1.73019176
## Woody material:grasslandHerbaceous-Needles:grasslandHerbaceous	-2.61800979
## Flowers:shrubScrub-Needles:grasslandHerbaceous	-2.96718095
## Leaves:shrubScrub-Needles:grasslandHerbaceous	-2.94591907
## Mixed:shrubScrub-Needles:grasslandHerbaceous	-0.21681916
## Needles:shrubScrub-Needles:grasslandHerbaceous	1.38913220
## Other:shrubScrub-Needles:grasslandHerbaceous	-2.92967413
## Seeds:shrubScrub-Needles:grasslandHerbaceous	-2.95852105
## Twigs/branches:shrubScrub-Needles:grasslandHerbaceous	-2.53355046

## Woody material:shrubScrub-Needles:grasslandHerbaceous	-2.88516505
## Seeds:grasslandHerbaceous-Other:grasslandHerbaceous	2.50765611
## Twigs/branches:grasslandHerbaceous-Other:grasslandHerbaceous	3.42601912
## Woody material:grasslandHerbaceous-Other:grasslandHerbaceous	2.53782327
## Flowers:shrubScrub-Other:grasslandHerbaceous	2.19887058
## Leaves:shrubScrub-Other:grasslandHerbaceous	2.22095539
## Mixed:shrubScrub-Other:grasslandHerbaceous	4.93412210
## Needles:shrubScrub-Other:grasslandHerbaceous	6.55647016
## Other:shrubScrub-Other:grasslandHerbaceous	2.23687902
## Seeds:shrubScrub-Other:grasslandHerbaceous	2.20770040
## Twigs/branches:shrubScrub-Other:grasslandHerbaceous	2.63363538
## Woody material:shrubScrub-Other:grasslandHerbaceous	2.28202080
## Twigs/branches:grasslandHerbaceous-Seeds:grasslandHerbaceous	3.51726912
## Woody material:grasslandHerbaceous-Seeds:grasslandHerbaceous	2.62907327
## Flowers:shrubScrub-Seeds:grasslandHerbaceous	2.29012058
## Leaves:shrubScrub-Seeds:grasslandHerbaceous	2.31220539
## Mixed:shrubScrub-Seeds:grasslandHerbaceous	5.02537210
## Needles:shrubScrub-Seeds:grasslandHerbaceous	6.64772016
## Other:shrubScrub-Seeds:grasslandHerbaceous	2.32812902
## Seeds:shrubScrub-Seeds:grasslandHerbaceous	2.29895040
## Twigs/branches:shrubScrub-Seeds:grasslandHerbaceous	2.72488538
## Woody material:shrubScrub-Seeds:grasslandHerbaceous	2.37327080
## Woody material:grasslandHerbaceous-Twigs/branches:grasslandHerbaceous	1.65833394
## Flowers:shrubScrub-Twigs/branches:grasslandHerbaceous	1.31581849
## Leaves:shrubScrub-Twigs/branches:grasslandHerbaceous	1.33761771
## Mixed:shrubScrub-Twigs/branches:grasslandHerbaceous	4.05634846
## Needles:shrubScrub-Twigs/branches:grasslandHerbaceous	5.67297172
## Other:shrubScrub-Twigs/branches:grasslandHerbaceous	1.35365282
## Seeds:shrubScrub-Twigs/branches:grasslandHerbaceous	1.32458932
## Twigs/branches:shrubScrub-Twigs/branches:grasslandHerbaceous	1.75018969
## Woody material:shrubScrub-Twigs/branches:grasslandHerbaceous	1.39857510
## Flowers:shrubScrub-Woody material:grasslandHerbaceous	2.23149510
## Leaves:shrubScrub-Woody material:grasslandHerbaceous	2.25343562
## Mixed:shrubScrub-Woody material:grasslandHerbaceous	4.96941799
## Needles:shrubScrub-Woody material:grasslandHerbaceous	6.58886918
## Other:shrubScrub-Woody material:grasslandHerbaceous	2.26941557
## Seeds:shrubScrub-Woody material:grasslandHerbaceous	2.24029511
## Twigs/branches:shrubScrub-Woody material:grasslandHerbaceous	2.66606105
## Woody material:shrubScrub-Woody material:grasslandHerbaceous	2.31444646
## Leaves:shrubScrub-Flowers:shrubScrub	1.92648477
## Mixed:shrubScrub-Flowers:shrubScrub	4.71791787
## Needles:shrubScrub-Flowers:shrubScrub	6.25962171
## Other:shrubScrub-Flowers:shrubScrub	1.94405289
## Seeds:shrubScrub-Flowers:shrubScrub	1.91656874
## Twigs/branches:shrubScrub-Flowers:shrubScrub	2.33756804
## Woody material:shrubScrub-Flowers:shrubScrub	1.98595346
## Mixed:shrubScrub-Leaves:shrubScrub	4.65477481
## Needles:shrubScrub-Leaves:shrubScrub	6.19008841
## Other:shrubScrub-Leaves:shrubScrub	1.87485713
## Seeds:shrubScrub-Leaves:shrubScrub	1.84751452
## Twigs/branches:shrubScrub-Leaves:shrubScrub	2.26810046
## Woody material:shrubScrub-Leaves:shrubScrub	1.91648588
## Needles:shrubScrub-Mixed:shrubScrub	4.57671112
## Other:shrubScrub-Mixed:shrubScrub	0.25556530

## Seeds:shrubScrub-Mixed:shrubScrub	0.22572816
## Twigs/branches:shrubScrub-Mixed:shrubScrub	0.65357537
## Woody material:shrubScrub-Mixed:shrubScrub	0.30196079
## Other:shrubScrub-Needles:shrubScrub	-2.48683241
## Seeds:shrubScrub-Needles:shrubScrub	-2.51409457
## Twigs/branches:shrubScrub-Needles:shrubScrub	-2.09374366
## Woody material:shrubScrub-Needles:shrubScrub	-2.44535825
## Seeds:shrubScrub-Other:shrubScrub	1.84983111
## Twigs/branches:shrubScrub-Other:shrubScrub	2.27057903
## Woody material:shrubScrub-Other:shrubScrub	1.91896445
## Twigs/branches:shrubScrub-Seeds:shrubScrub	2.31888702
## Woody material:shrubScrub-Seeds:shrubScrub	1.96727244
## Woody material:shrubScrub-Twigs/branches:shrubScrub	1.48608955
##	p adj
## Leaves:evergreenForest-Flowers:evergreenForest	1.0000000
## Mixed:evergreenForest-Flowers:evergreenForest	0.7778267
## Needles:evergreenForest-Flowers:evergreenForest	0.0000000
## Other:evergreenForest-Flowers:evergreenForest	1.0000000
## Seeds:evergreenForest-Flowers:evergreenForest	1.0000000
## Twigs/branches:evergreenForest-Flowers:evergreenForest	0.0576184
## Woody material:evergreenForest-Flowers:evergreenForest	0.9348463
## Flowers:grasslandHerbaceous-Flowers:evergreenForest	1.0000000
## Leaves:grasslandHerbaceous-Flowers:evergreenForest	1.0000000
## Mixed:grasslandHerbaceous-Flowers:evergreenForest	0.9999809
## Needles:grasslandHerbaceous-Flowers:evergreenForest	0.0000000
## Other:grasslandHerbaceous-Flowers:evergreenForest	1.0000000
## Seeds:grasslandHerbaceous-Flowers:evergreenForest	1.0000000
## Twigs/branches:grasslandHerbaceous-Flowers:evergreenForest	0.9998164
## Woody material:grasslandHerbaceous-Flowers:evergreenForest	1.0000000
## Flowers:shrubScrub-Flowers:evergreenForest	1.0000000
## Leaves:shrubScrub-Flowers:evergreenForest	1.0000000
## Mixed:shrubScrub-Flowers:evergreenForest	0.2255973
## Needles:shrubScrub-Flowers:evergreenForest	0.0000000
## Other:shrubScrub-Flowers:evergreenForest	1.0000000
## Seeds:shrubScrub-Flowers:evergreenForest	1.0000000
## Twigs/branches:shrubScrub-Flowers:evergreenForest	1.0000000
## Woody material:shrubScrub-Flowers:evergreenForest	1.0000000
## Mixed:evergreenForest-Leaves:evergreenForest	0.6690792
## Needles:evergreenForest-Leaves:evergreenForest	0.0000000
## Other:evergreenForest-Leaves:evergreenForest	1.0000000
## Seeds:evergreenForest-Leaves:evergreenForest	1.0000000
## Twigs/branches:evergreenForest-Leaves:evergreenForest	0.0330188
## Woody material:evergreenForest-Leaves:evergreenForest	0.8603312
## Flowers:grasslandHerbaceous-Leaves:evergreenForest	1.0000000
## Leaves:grasslandHerbaceous-Leaves:evergreenForest	1.0000000
## Mixed:grasslandHerbaceous-Leaves:evergreenForest	0.9999002
## Needles:grasslandHerbaceous-Leaves:evergreenForest	0.0000000
## Other:grasslandHerbaceous-Leaves:evergreenForest	1.0000000
## Seeds:grasslandHerbaceous-Leaves:evergreenForest	1.0000000
## Twigs/branches:grasslandHerbaceous-Leaves:evergreenForest	0.9989083
## Woody material:grasslandHerbaceous-Leaves:evergreenForest	1.0000000
## Flowers:shrubScrub-Leaves:evergreenForest	1.0000000
## Leaves:shrubScrub-Leaves:evergreenForest	1.0000000
## Mixed:shrubScrub-Leaves:evergreenForest	0.1595595

## Needles:shrubScrub-Leaves:evergreenForest	0.0000000
## Other:shrubScrub-Leaves:evergreenForest	1.0000000
## Seeds:shrubScrub-Leaves:evergreenForest	1.0000000
## Twigs/branches:shrubScrub-Leaves:evergreenForest	0.9999999
## Woody material:shrubScrub-Leaves:evergreenForest	1.0000000
## Needles:evergreenForest-Mixed:evergreenForest	0.0000000
## Other:evergreenForest-Mixed:evergreenForest	0.7484244
## Seeds:evergreenForest-Mixed:evergreenForest	0.7358868
## Twigs/branches:evergreenForest-Mixed:evergreenForest	1.0000000
## Woody material:evergreenForest-Mixed:evergreenForest	1.0000000
## Flowers:grasslandHerbaceous-Mixed:evergreenForest	0.8397321
## Leaves:grasslandHerbaceous-Mixed:evergreenForest	0.8215293
## Mixed:grasslandHerbaceous-Mixed:evergreenForest	1.0000000
## Needles:grasslandHerbaceous-Mixed:evergreenForest	0.0000863
## Other:grasslandHerbaceous-Mixed:evergreenForest	0.8971129
## Seeds:grasslandHerbaceous-Mixed:evergreenForest	0.8329319
## Twigs/branches:grasslandHerbaceous-Mixed:evergreenForest	0.9999995
## Woody material:grasslandHerbaceous-Mixed:evergreenForest	0.8600140
## Flowers:shrubScrub-Mixed:evergreenForest	0.6203713
## Leaves:shrubScrub-Mixed:evergreenForest	0.6564316
## Mixed:shrubScrub-Mixed:evergreenForest	1.0000000
## Needles:shrubScrub-Mixed:evergreenForest	0.0016783
## Other:shrubScrub-Mixed:evergreenForest	0.6730863
## Seeds:shrubScrub-Mixed:evergreenForest	0.6332449
## Twigs/branches:shrubScrub-Mixed:evergreenForest	0.9767066
## Woody material:shrubScrub-Mixed:evergreenForest	0.7336731
## Other:evergreenForest-Needles:evergreenForest	0.0000000
## Seeds:evergreenForest-Needles:evergreenForest	0.0000000
## Twigs/branches:evergreenForest-Needles:evergreenForest	0.0000000
## Woody material:evergreenForest-Needles:evergreenForest	0.0000000
## Flowers:grasslandHerbaceous-Needles:evergreenForest	0.0000000
## Leaves:grasslandHerbaceous-Needles:evergreenForest	0.0000000
## Mixed:grasslandHerbaceous-Needles:evergreenForest	0.0000000
## Needles:grasslandHerbaceous-Needles:evergreenForest	0.0354026
## Other:grasslandHerbaceous-Needles:evergreenForest	0.0000000
## Seeds:grasslandHerbaceous-Needles:evergreenForest	0.0000000
## Twigs/branches:grasslandHerbaceous-Needles:evergreenForest	0.0000000
## Woody material:grasslandHerbaceous-Needles:evergreenForest	0.0000000
## Flowers:shrubScrub-Needles:evergreenForest	0.0000000
## Leaves:shrubScrub-Needles:evergreenForest	0.0000000
## Mixed:shrubScrub-Needles:evergreenForest	0.0000000
## Needles:shrubScrub-Needles:evergreenForest	0.0000011
## Other:shrubScrub-Needles:evergreenForest	0.0000000
## Seeds:shrubScrub-Needles:evergreenForest	0.0000000
## Twigs/branches:shrubScrub-Needles:evergreenForest	0.0000000
## Woody material:shrubScrub-Needles:evergreenForest	0.0000000
## Seeds:evergreenForest-Other:evergreenForest	1.0000000
## Twigs/branches:evergreenForest-Other:evergreenForest	0.0505597
## Woody material:evergreenForest-Other:evergreenForest	0.9173794
## Flowers:grasslandHerbaceous-Other:evergreenForest	1.0000000
## Leaves:grasslandHerbaceous-Other:evergreenForest	1.0000000
## Mixed:grasslandHerbaceous-Other:evergreenForest	0.9999668
## Needles:grasslandHerbaceous-Other:evergreenForest	0.0000000
## Other:grasslandHerbaceous-Other:evergreenForest	1.0000000



## Seeds:grasslandHerbaceous-Other:evergreenForest	1.0000000
## Twigs/branches:grasslandHerbaceous-Other:evergreenForest	0.9996690
## Woody material:grasslandHerbaceous-Other:evergreenForest	1.0000000
## Flowers:shrubScrub-Other:evergreenForest	1.0000000
## Leaves:shrubScrub-Other:evergreenForest	1.0000000
## Mixed:shrubScrub-Other:evergreenForest	0.2058815
## Needles:shrubScrub-Other:evergreenForest	0.0000000
## Other:shrubScrub-Other:evergreenForest	1.0000000
## Seeds:shrubScrub-Other:evergreenForest	1.0000000
## Twigs/branches:shrubScrub-Other:evergreenForest	1.0000000
## Woody material:shrubScrub-Other:evergreenForest	1.0000000
## Twigs/branches:evergreenForest-Seeds:evergreenForest	0.0472061
## Woody material:evergreenForest-Seeds:evergreenForest	0.9092750
## Flowers:grasslandHerbaceous-Seeds:evergreenForest	1.0000000
## Leaves:grasslandHerbaceous-Seeds:evergreenForest	1.0000000
## Mixed:grasslandHerbaceous-Seeds:evergreenForest	0.9999599
## Needles:grasslandHerbaceous-Seeds:evergreenForest	0.0000000
## Other:grasslandHerbaceous-Seeds:evergreenForest	1.0000000
## Seeds:grasslandHerbaceous-Seeds:evergreenForest	1.0000000
## Twigs/branches:grasslandHerbaceous-Seeds:evergreenForest	0.9995923
## Woody material:grasslandHerbaceous-Seeds:evergreenForest	1.0000000
## Flowers:shrubScrub-Seeds:evergreenForest	1.0000000
## Leaves:shrubScrub-Seeds:evergreenForest	1.0000000
## Mixed:shrubScrub-Seeds:evergreenForest	0.1976538
## Needles:shrubScrub-Seeds:evergreenForest	0.0000000
## Other:shrubScrub-Seeds:evergreenForest	1.0000000
## Seeds:shrubScrub-Seeds:evergreenForest	1.0000000
## Twigs/branches:shrubScrub-Seeds:evergreenForest	1.0000000
## Woody material:shrubScrub-Seeds:evergreenForest	1.0000000
## Woody material:evergreenForest-Twigs/branches:evergreenForest	0.9934408
## Flowers:grasslandHerbaceous-Twigs/branches:evergreenForest	0.1553770
## Leaves:grasslandHerbaceous-Twigs/branches:evergreenForest	0.1230330
## Mixed:grasslandHerbaceous-Twigs/branches:evergreenForest	0.9999929
## Needles:grasslandHerbaceous-Twigs/branches:evergreenForest	0.0001009
## Other:grasslandHerbaceous-Twigs/branches:evergreenForest	0.2125736
## Seeds:grasslandHerbaceous-Twigs/branches:evergreenForest	0.1463923
## Twigs/branches:grasslandHerbaceous-Twigs/branches:evergreenForest	0.9819556
## Woody material:grasslandHerbaceous-Twigs/branches:evergreenForest	0.1662533
## Flowers:shrubScrub-Twigs/branches:evergreenForest	0.0208356
## Leaves:shrubScrub-Twigs/branches:evergreenForest	0.0233702
## Mixed:shrubScrub-Twigs/branches:evergreenForest	1.0000000
## Needles:shrubScrub-Twigs/branches:evergreenForest	0.0019104
## Other:shrubScrub-Twigs/branches:evergreenForest	0.0264478
## Seeds:shrubScrub-Twigs/branches:evergreenForest	0.0219725
## Twigs/branches:shrubScrub-Twigs/branches:evergreenForest	0.2503203
## Woody material:shrubScrub-Twigs/branches:evergreenForest	0.0349431
## Flowers:grasslandHerbaceous-Woody material:evergreenForest	0.9653227
## Leaves:grasslandHerbaceous-Woody material:evergreenForest	0.9578392
## Mixed:grasslandHerbaceous-Woody material:evergreenForest	1.0000000
## Needles:grasslandHerbaceous-Woody material:evergreenForest	0.0000000
## Other:grasslandHerbaceous-Woody material:evergreenForest	0.9849724
## Seeds:grasslandHerbaceous-Woody material:evergreenForest	0.9625766
## Twigs/branches:grasslandHerbaceous-Woody material:evergreenForest	1.0000000
## Woody material:grasslandHerbaceous-Woody material:evergreenForest	0.9732104

## Flowers:shrubScrub-Woody material:evergreenForest	0.8153558
## Leaves:shrubScrub-Woody material:evergreenForest	0.8460174
## Mixed:shrubScrub-Woody material:evergreenForest	0.9969846
## Needles:shrubScrub-Woody material:evergreenForest	0.0000001
## Other:shrubScrub-Woody material:evergreenForest	0.8604142
## Seeds:shrubScrub-Woody material:evergreenForest	0.8267656
## Twigs/branches:shrubScrub-Woody material:evergreenForest	0.9993323
## Woody material:shrubScrub-Woody material:evergreenForest	0.9053484
## Leaves:grasslandHerbaceous-Flowers:grasslandHerbaceous	1.0000000
## Mixed:grasslandHerbaceous-Flowers:grasslandHerbaceous	0.9999603
## Needles:grasslandHerbaceous-Flowers:grasslandHerbaceous	0.0000000
## Other:grasslandHerbaceous-Flowers:grasslandHerbaceous	1.0000000
## Seeds:grasslandHerbaceous-Flowers:grasslandHerbaceous	1.0000000
## Twigs/branches:grasslandHerbaceous-Flowers:grasslandHerbaceous	0.9997859
## Woody material:grasslandHerbaceous-Flowers:grasslandHerbaceous	1.0000000
## Flowers:shrubScrub-Flowers:grasslandHerbaceous	1.0000000
## Leaves:shrubScrub-Flowers:grasslandHerbaceous	1.0000000
## Mixed:shrubScrub-Flowers:grasslandHerbaceous	0.3178625
## Needles:shrubScrub-Flowers:grasslandHerbaceous	0.0000000
## Other:shrubScrub-Flowers:grasslandHerbaceous	1.0000000
## Seeds:shrubScrub-Flowers:grasslandHerbaceous	1.0000000
## Twigs/branches:shrubScrub-Flowers:grasslandHerbaceous	1.0000000
## Woody material:shrubScrub-Flowers:grasslandHerbaceous	1.0000000
## Mixed:grasslandHerbaceous-Leaves:grasslandHerbaceous	0.9999639
## Needles:grasslandHerbaceous-Leaves:grasslandHerbaceous	0.0000000
## Other:grasslandHerbaceous-Leaves:grasslandHerbaceous	1.0000000
## Seeds:grasslandHerbaceous-Leaves:grasslandHerbaceous	1.0000000
## Twigs/branches:grasslandHerbaceous-Leaves:grasslandHerbaceous	0.9997744
## Woody material:grasslandHerbaceous-Leaves:grasslandHerbaceous	1.0000000
## Flowers:shrubScrub-Leaves:grasslandHerbaceous	1.0000000
## Leaves:shrubScrub-Leaves:grasslandHerbaceous	1.0000000
## Mixed:shrubScrub-Leaves:grasslandHerbaceous	0.2890489
## Needles:shrubScrub-Leaves:grasslandHerbaceous	0.0000000
## Other:shrubScrub-Leaves:grasslandHerbaceous	1.0000000
## Seeds:shrubScrub-Leaves:grasslandHerbaceous	1.0000000
## Twigs/branches:shrubScrub-Leaves:grasslandHerbaceous	1.0000000
## Woody material:shrubScrub-Leaves:grasslandHerbaceous	1.0000000
## Needles:grasslandHerbaceous-Mixed:grasslandHerbaceous	0.0024284
## Other:grasslandHerbaceous-Mixed:grasslandHerbaceous	0.9999908
## Seeds:grasslandHerbaceous-Mixed:grasslandHerbaceous	0.9999581
## Twigs/branches:grasslandHerbaceous-Mixed:grasslandHerbaceous	1.0000000
## Woody material:grasslandHerbaceous-Mixed:grasslandHerbaceous	0.9999779
## Flowers:shrubScrub-Mixed:grasslandHerbaceous	0.9998753
## Leaves:shrubScrub-Mixed:grasslandHerbaceous	0.9999310
## Mixed:shrubScrub-Mixed:grasslandHerbaceous	0.9999731
## Needles:shrubScrub-Mixed:grasslandHerbaceous	0.0273593
## Other:shrubScrub-Mixed:grasslandHerbaceous	0.9999409
## Seeds:shrubScrub-Mixed:grasslandHerbaceous	0.9998963
## Twigs/branches:shrubScrub-Mixed:grasslandHerbaceous	1.0000000
## Woody material:shrubScrub-Mixed:grasslandHerbaceous	0.9999778
## Other:grasslandHerbaceous-Needles:grasslandHerbaceous	0.0000000
## Seeds:grasslandHerbaceous-Needles:grasslandHerbaceous	0.0000000
## Twigs/branches:grasslandHerbaceous-Needles:grasslandHerbaceous	0.0000002
## Woody material:grasslandHerbaceous-Needles:grasslandHerbaceous	0.0000000

## Flowers:shrubScrub-Needles:grasslandHerbaceous	0.0000000
## Leaves:shrubScrub-Needles:grasslandHerbaceous	0.0000000
## Mixed:shrubScrub-Needles:grasslandHerbaceous	0.0178115
## Needles:shrubScrub-Needles:grasslandHerbaceous	0.9998496
## Other:shrubScrub-Needles:grasslandHerbaceous	0.0000000
## Seeds:shrubScrub-Needles:grasslandHerbaceous	0.0000000
## Twigs/branches:shrubScrub-Needles:grasslandHerbaceous	0.0000000
## Woody material:shrubScrub-Needles:grasslandHerbaceous	0.0000000
## Seeds:grasslandHerbaceous-Other:grasslandHerbaceous	1.0000000
## Twigs/branches:grasslandHerbaceous-Other:grasslandHerbaceous	0.9999580
## Woody material:grasslandHerbaceous-Other:grasslandHerbaceous	1.0000000
## Flowers:shrubScrub-Other:grasslandHerbaceous	1.0000000
## Leaves:shrubScrub-Other:grasslandHerbaceous	1.0000000
## Mixed:shrubScrub-Other:grasslandHerbaceous	0.3929171
## Needles:shrubScrub-Other:grasslandHerbaceous	0.0000000
## Other:shrubScrub-Other:grasslandHerbaceous	1.0000000
## Seeds:shrubScrub-Other:grasslandHerbaceous	1.0000000
## Twigs/branches:shrubScrub-Other:grasslandHerbaceous	1.0000000
## Woody material:shrubScrub-Other:grasslandHerbaceous	1.0000000
## Twigs/branches:grasslandHerbaceous-Seeds:grasslandHerbaceous	0.9997661
## Woody material:grasslandHerbaceous-Seeds:grasslandHerbaceous	1.0000000
## Flowers:shrubScrub-Seeds:grasslandHerbaceous	1.0000000
## Leaves:shrubScrub-Seeds:grasslandHerbaceous	1.0000000
## Mixed:shrubScrub-Seeds:grasslandHerbaceous	0.3086423
## Needles:shrubScrub-Seeds:grasslandHerbaceous	0.0000000
## Other:shrubScrub-Seeds:grasslandHerbaceous	1.0000000
## Seeds:shrubScrub-Seeds:grasslandHerbaceous	1.0000000
## Twigs/branches:shrubScrub-Seeds:grasslandHerbaceous	1.0000000
## Woody material:shrubScrub-Seeds:grasslandHerbaceous	1.0000000
## Woody material:grasslandHerbaceous-Twigs/branches:grasslandHerbaceous	0.9998831
## Flowers:shrubScrub-Twigs/branches:grasslandHerbaceous	0.9984073
## Leaves:shrubScrub-Twigs/branches:grasslandHerbaceous	0.9990989
## Mixed:shrubScrub-Twigs/branches:grasslandHerbaceous	0.9883079
## Needles:shrubScrub-Twigs/branches:grasslandHerbaceous	0.0000043
## Other:shrubScrub-Twigs/branches:grasslandHerbaceous	0.9992548
## Seeds:shrubScrub-Twigs/branches:grasslandHerbaceous	0.9986731
## Twigs/branches:shrubScrub-Twigs/branches:grasslandHerbaceous	1.0000000
## Woody material:shrubScrub-Twigs/branches:grasslandHerbaceous	0.9997323
## Flowers:shrubScrub-Woody material:grasslandHerbaceous	1.0000000
## Leaves:shrubScrub-Woody material:grasslandHerbaceous	1.0000000
## Mixed:shrubScrub-Woody material:grasslandHerbaceous	0.3382995
## Needles:shrubScrub-Woody material:grasslandHerbaceous	0.0000000
## Other:shrubScrub-Woody material:grasslandHerbaceous	1.0000000
## Seeds:shrubScrub-Woody material:grasslandHerbaceous	1.0000000
## Twigs/branches:shrubScrub-Woody material:grasslandHerbaceous	1.0000000
## Woody material:shrubScrub-Woody material:grasslandHerbaceous	1.0000000
## Leaves:shrubScrub-Flowers:shrubScrub	1.0000000
## Mixed:shrubScrub-Flowers:shrubScrub	0.1324031
## Needles:shrubScrub-Flowers:shrubScrub	0.0000000
## Other:shrubScrub-Flowers:shrubScrub	1.0000000
## Seeds:shrubScrub-Flowers:shrubScrub	1.0000000
## Twigs/branches:shrubScrub-Flowers:shrubScrub	0.9999998
## Woody material:shrubScrub-Flowers:shrubScrub	1.0000000
## Mixed:shrubScrub-Leaves:shrubScrub	0.1468958

```
## Needles:shrubScrub-Leaves:shrubScrub 0.0000000
## Other:shrubScrub-Leaves:shrubScrub 1.0000000
## Seeds:shrubScrub-Leaves:shrubScrub 1.0000000
## Twigs/branches:shrubScrub-Leaves:shrubScrub 1.0000000
## Woody material:shrubScrub-Leaves:shrubScrub 1.0000000
## Needles:shrubScrub-Mixed:shrubScrub 0.1840347
## Other:shrubScrub-Mixed:shrubScrub 0.1556683
## Seeds:shrubScrub-Mixed:shrubScrub 0.1376605
## Twigs/branches:shrubScrub-Mixed:shrubScrub 0.5427234
## Woody material:shrubScrub-Mixed:shrubScrub 0.1875831
## Other:shrubScrub-Needles:shrubScrub 0.0000000
## Seeds:shrubScrub-Needles:shrubScrub 0.0000000
## Twigs/branches:shrubScrub-Needles:shrubScrub 0.0000000
## Woody material:shrubScrub-Needles:shrubScrub 0.0000000
## Seeds:shrubScrub-Other:shrubScrub 1.0000000
## Twigs/branches:shrubScrub-Other:shrubScrub 1.0000000
## Woody material:shrubScrub-Other:shrubScrub 1.0000000
## Twigs/branches:shrubScrub-Seeds:shrubScrub 0.9999999
## Woody material:shrubScrub-Seeds:shrubScrub 1.0000000
## Woody material:shrubScrub-Twigs/branches:shrubScrub 1.0000000
```

```
Litter.interaction <- with(Litter, interaction(functionalGroup, nlcdClass))
```

```
#Litter.test <- cbind(Litter, Litter.interaction)
```

```
Litter.anova.2way5 <- aov(data = Litter, dryMass ~ Litter.interaction) #one way anova but with ineraction
```

```
Litter.groups <- HSD.test(Litter.anova.2way5, "Litter.interaction", group = TRUE)
Litter.groups
```

```
## $statistics
##      MSerror   Df      Mean      CV
##  12.21141 1668  1.185757 294.7049
##
## $parameters
##      test          name.t ntr StudentizedRange alpha
##   Tukey Litter.interaction  24          5.152623  0.05
##
## $means
##
##              dryMass      std  r   Min   Max
## Flowers.evergreenForest  0.119625000  0.17831805  80 0.000  0.96
## Flowers.grasslandHerbaceous  0.005425532  0.01342571  47 0.000  0.08
## Flowers.shrubScrub  0.015505618  0.06134406  89 0.000  0.51
## Leaves.evergreenForest  0.016025641  0.06633425  78 0.000  0.53
## Leaves.grasslandHerbaceous  0.030471698  0.06550297  53 0.000  0.30
## Leaves.shrubScrub  0.058936170  0.16177256  94 0.000  1.13
## Mixed.evergreenForest  1.624375000  2.17737389  48 0.000  9.36
## Mixed.grasslandHerbaceous  1.129000000  1.84876744  20 0.000  5.93
## Mixed.shrubScrub  2.266184211  6.21960191  38 0.005 24.60
## Needles.evergreenForest  7.431888889  8.73545377  90 0.820 42.84
## Needles.grasslandHerbaceous  5.178888889 10.50178752  54 0.005 54.23
## Needles.shrubScrub  4.406288660  5.04363343  97 0.040 25.32
## Other.evergreenForest  0.084807692  0.13335687  78 0.000  0.56
## Other.grasslandHerbaceous  0.096666667  0.34639378  48 0.000  2.29
## Other.shrubScrub  0.066576087  0.22538481  92 0.000  1.68
```

##	Seeds.evergreenForest	0.073461538	0.23380715	78	0.000	1.29
##	Seeds.grasslandHerbaceous	0.005416667	0.01573833	48	0.000	0.10
##	Seeds.shrubScrub	0.028777778	0.10191236	90	0.000	0.73
##	Twigs/branches.evergreenForest	2.079294118	5.10954482	85	0.000	26.64
##	Twigs/branches.grasslandHerbaceous	0.949900000	3.70166020	50	0.000	21.13
##	Twigs/branches.shrubScrub	0.479583333	0.92559331	96	0.000	5.21
##	Woody material.evergreenForest	1.203936170	2.51804689	94	0.000	18.13
##	Woody material.grasslandHerbaceous	0.048877551	0.11809365	49	0.000	0.58
##	Woody material.shrubScrub	0.127968750	0.35611765	96	0.000	2.52
##		Q25	Q50	Q75		
##	Flowers.evergreenForest	0.0050	0.0600	0.1625		
##	Flowers.grasslandHerbaceous	0.0000	0.0000	0.0050		
##	Flowers.shrubScrub	0.0000	0.0050	0.0050		
##	Leaves.evergreenForest	0.0000	0.0000	0.0050		
##	Leaves.grasslandHerbaceous	0.0000	0.0050	0.0200		
##	Leaves.shrubScrub	0.0000	0.0050	0.0200		
##	Mixed.evergreenForest	0.3400	0.7450	1.6500		
##	Mixed.grasslandHerbaceous	0.0050	0.0500	1.8525		
##	Mixed.shrubScrub	0.0575	0.1500	0.9575		
##	Needles.evergreenForest	2.4100	3.7350	8.8475		
##	Needles.grasslandHerbaceous	0.3200	1.8950	4.1175		
##	Needles.shrubScrub	1.0600	2.1900	6.4000		
##	Other.evergreenForest	0.0000	0.0050	0.1500		
##	Other.grasslandHerbaceous	0.0000	0.0025	0.0400		
##	Other.shrubScrub	0.0000	0.0025	0.0325		
##	Seeds.evergreenForest	0.0000	0.0050	0.0400		
##	Seeds.grasslandHerbaceous	0.0000	0.0000	0.0050		
##	Seeds.shrubScrub	0.0000	0.0000	0.0050		
##	Twigs/branches.evergreenForest	0.0000	0.2400	1.3300		
##	Twigs/branches.grasslandHerbaceous	0.0050	0.0600	0.3375		
##	Twigs/branches.shrubScrub	0.0000	0.0700	0.4750		
##	Woody material.evergreenForest	0.0325	0.2400	1.2975		
##	Woody material.grasslandHerbaceous	0.0000	0.0050	0.0200		
##	Woody material.shrubScrub	0.0000	0.0050	0.0725		
##						
##	\$comparison					
##	NULL					
##						
##	\$groups					
##		dryMass groups				
##	Needles.evergreenForest	7.431888889		a		
##	Needles.grasslandHerbaceous	5.178888889		b		
##	Needles.shrubScrub	4.406288660		bc		
##	Mixed.shrubScrub	2.266184211		cd		
##	Twigs/branches.evergreenForest	2.079294118		d		
##	Mixed.evergreenForest	1.624375000		d		
##	Woody material.evergreenForest	1.203936170		d		
##	Mixed.grasslandHerbaceous	1.129000000		d		
##	Twigs/branches.grasslandHerbaceous	0.949900000		d		
##	Twigs/branches.shrubScrub	0.479583333		d		
##	Woody material.shrubScrub	0.127968750		d		
##	Flowers.evergreenForest	0.119625000		d		
##	Other.grasslandHerbaceous	0.096666667		d		
##	Other.evergreenForest	0.084807692		d		

```
## Seeds.evergreenForest          0.073461538      d
## Other.shrubScrub               0.066576087      d
## Leaves.shrubScrub              0.058936170      d
## Woody material.grasslandHerbaceous 0.048877551      d
## Leaves.grasslandHerbaceous      0.030471698      d
## Seeds.shrubScrub               0.028777778      d
## Leaves.evergreenForest         0.016025641      d
## Flowers.shrubScrub             0.015505618      d
## Flowers.grasslandHerbaceous     0.005425532      d
## Seeds.grasslandHerbaceous       0.005416667      d
##
## attr(,"class")
## [1] "group"

# Plot the results
# Edit this graph to make it more visually appealing.
# Add letters to represent statistical groupings.
Litter.anova.plot <- ggplot(Litter, aes(y = dryMass, x = nlcdClass, color = functionalGroup)) +
  geom_boxplot() +
  stat_summary(geom = "text", fun = max, vjust = -1, size = 3.5,
              label = c("a", "b", "bc", "cd", "d", "d", "d", "d", "d", "d", "d", "d", "d", "d", "d", "d", "d", "d"),
              labs(x = "Land Cover Class", y = "Dry Mass (g)"))
print(Litter.anova.plot)
```

