Electronic Supplementary Material 2

Results of the RLQ and fourth corner anlaysis on a reduced dataset where all sites are separated at least 1 degree longitude and latitude in all directions from each other

Katheirne Williams, Helen Slater, Phillipa Gillingham, Amanda Korstjens

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Genus level analysis

RLQ analysis results

Summary output of the RLQ analysis, including decomposition of inertia (contributions of individual variables to total model inertia and to the first two RLQ axes).

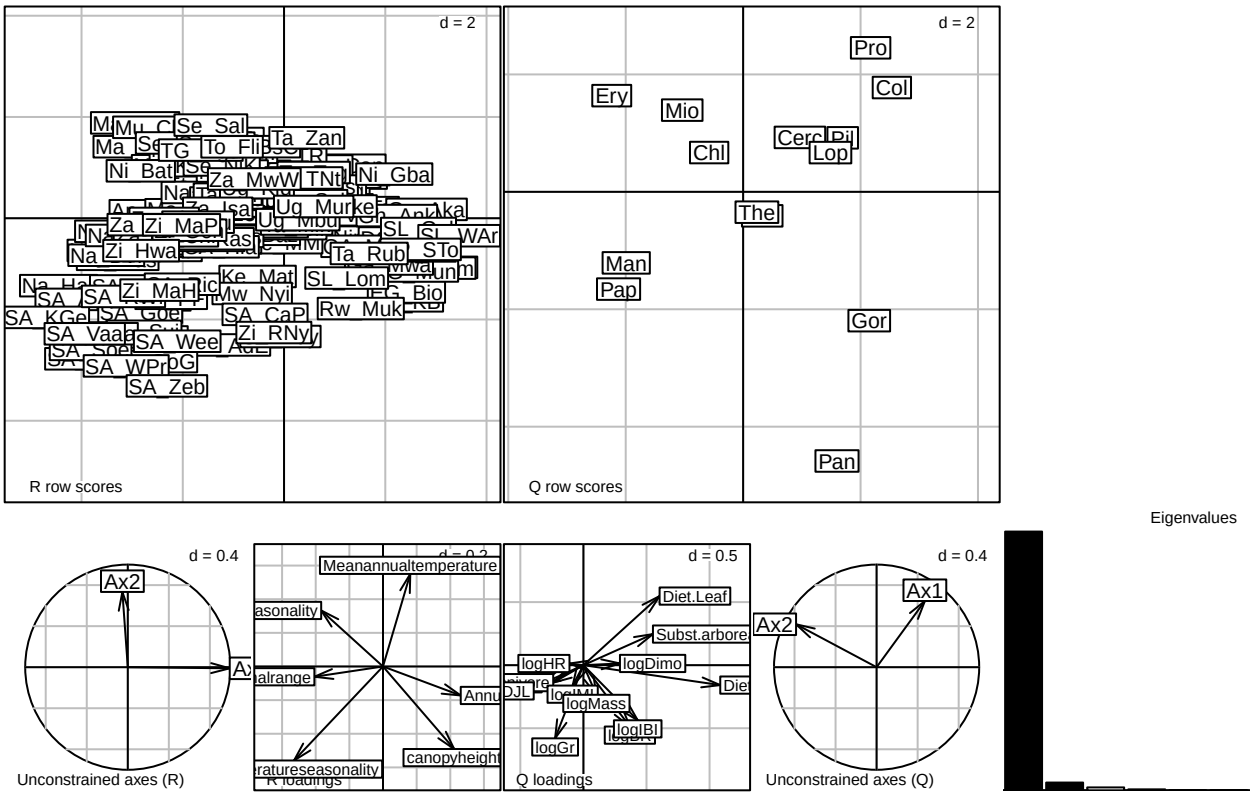
```
## RLQ analysis
##
## Class: rlq dudi
## Call: rlq(dudiR = acpR.genus, dudiL = afcL.genus, dudiQ = acpQ.genus,
##     scannf = FALSE)
##
## Total inertia: 1.854
##
## Eigenvalues:
##       Ax1       Ax2       Ax3       Ax4       Ax5
## 1.7732264 0.0532216 0.0199124 0.0066666 0.0008491
##
## Projected inertia (%):
##      Ax1      Ax2      Ax3      Ax4      Ax5
## 95.63756  2.87046  1.07396  0.35956  0.04579
##
## Cumulative projected inertia (%):
##     Ax1   Ax1:2   Ax1:3   Ax1:4   Ax1:5
##   95.64   98.51   99.58   99.94   99.99
##
## (Only 5 dimensions (out of 6) are shown)
##
##
## Eigenvalues decomposition:
##          eig    covar       sdR      sdQ      corr
## 1 1.77322639 1.331625 1.7214828 1.678700 0.4607935
## 2 0.05322156 0.230698 0.9631832 1.693464 0.1414357
##
## Inertia & coinertia R (acpR.genus):
##     inertia      max     ratio
```

```
## 1  2.963503 2.994005 0.9898123
## 12 3.891225 4.287115 0.9076559
##
## Inertia & coinertia Q (acpQ.genus):
##     inertia      max     ratio
## 1  2.818033 5.023742 0.5609429
## 12 5.685852 7.565502 0.7515499
##
## Correlation L (afcL.genus):
##        corr       max     ratio
## 1 0.4607935 0.7136752 0.6456628
## 2 0.1414357 0.5115256 0.2764977
## Inertia information:
## Call: inertia.dudi(x = rlq.genus, row.inertia = TRUE, col.inertia = TRUE)
##
## Decomposition of total inertia:
##       inertia     cum  cum(%)
## Ax1 1.7732264   1.773   95.64
## Ax2 0.0532216   1.826   98.51
## Ax3 0.0199124   1.846   99.58
## Ax4 0.0066666   1.853   99.94
## Ax5 0.0008491   1.854   99.99
## Ax6 0.0002348   1.854  100.00
##
## Row contributions (%):
##    Meanannualtemperature  Temperaturediurnalrange   Temperatureseasonality
##                    3.815                   16.192                   27.807
##      Annualprecipitation Precipitationseasonality             canopyheight
##                   20.606                   13.463                   18.118
##
## Row absolute contributions (%):
##                             Axis1   Axis2
## Meanannualtemperature      2.629 30.2791
## Temperaturediurnalrange   16.647  0.3743
## Temperatureseasonality    27.963 31.2157
## Annualprecipitation       21.350  2.9699
## Precipitationseasonality  13.507 11.0966
## canopyheight              17.904 24.0644
##
## Signed row relative contributions:
##                             Axis1    Axis2
## Meanannualtemperature      65.90 22.78229
## Temperaturediurnalrange   -98.33 -0.06636
## Temperatureseasonality    -96.17 -3.22236
## Annualprecipitation        99.09 -0.41371
## Precipitationseasonality  -95.96  2.36599
## canopyheight               94.51 -3.81260
##
## Cumulative sum of row relative contributions (%):
##                             Axis1 Axis1:2 Axis3:6
## Meanannualtemperature      65.90   88.68 11.3211
## Temperaturediurnalrange    98.33   98.40  1.6037
## Temperatureseasonality     96.17   99.40  0.6028
## Annualprecipitation        99.09   99.50  0.4973
```

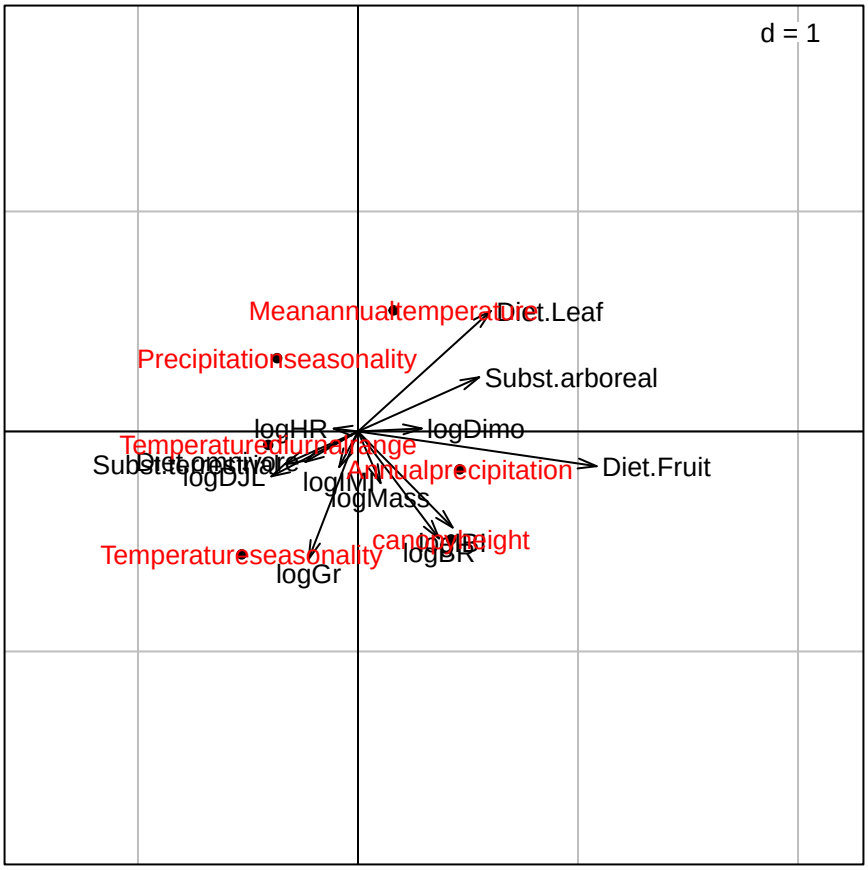
```
## Precipitationseasonality   95.96   98.32  1.6790
## canopyheight               94.51   98.32  1.6795
##
## Column contributions (%):
##    Subst.arboreal Subst.terrestrial        Diet.Fruit         Diet.Leaf
##           11.0082            6.5999            6.1927            7.3050
##     Diet.omnivore            logIMI           logMass             logGr
##            4.1585            0.9351            1.3546            5.8925
##             logBR           logDimo            logIBI             logHR
##           13.6679            8.1534           18.2798            1.4935
##            logDJL
##           14.9589
##
## Column absolute contributions (%):
##                      Axis1    Axis2
## Subst.arboreal     11.386  2.27832
## Subst.terrestrial   6.826  1.36595
## Diet.Fruit          6.061  0.12833
## Diet.Leaf           7.407  6.09540
## Diet.omnivore       4.277  1.42744
## logIMI              0.730  2.61636
## logMass             1.056  5.50980
## logGr               5.033 33.63311
## logBR              13.570 23.66492
## logDimo             8.394  0.01823
## logIBI             18.526 19.07975
## logHR               1.223  0.01704
## logDJL             15.513  4.16536
##
## Signed column relative contributions:
##                      Axis1      Axis2
## Subst.arboreal      98.92   0.594088
## Subst.terrestrial  -98.92  -0.594088
## Diet.Fruit          93.60  -0.059482
## Diet.Leaf           96.98   2.395150
## Diet.omnivore      -98.36  -0.985315
## logIMI             -74.66  -8.031181
## logMass             74.53 -11.675835
## logGr              -81.68 -16.383983
## logBR               94.95  -4.969979
## logDimo             98.46   0.006419
## logIBI              96.93  -2.996079
## logHR              -78.32   0.032747
## logDJL             -99.18  -0.799290
##
## Cumulative sum of column relative contributions (%):
##                      Axis1 Axis1:2  Axis3:6
## Subst.arboreal      98.92   99.51  0.48835
## Subst.terrestrial   98.92   99.51  0.48835
## Diet.Fruit          93.60   93.66  6.34281
## Diet.Leaf           96.98   99.37  0.62741
## Diet.omnivore       98.36   99.34  0.65921
## logIMI              74.66   82.69 17.31236
## logMass             74.53   86.21 13.79327
```

```
## logGr              81.68   98.07  1.93256
## logBR              94.95   99.92  0.08084
## logDimo            98.46   98.46  1.53850
## logIBI             96.93   99.92  0.07724
## logHR              78.32   78.35 21.64572
## logDJL             99.18   99.98  0.02305
```

Plot summaries of RLQ analysis showing scores of sites, genera, biological traits and environmental variables in the RLQ matrix.




```
## Warning: Unused parameters: boxes
```



Fourth corner test results

Summary output showing test results for genus traits against environmental variables (Pseudo F for quantitative x qualitative and Pearson R for two quantitative variables).

```
## Fourth-corner Statistics
## -----------------------
## Permutation method  Comb. 2 and 4  ( 4999  permutations)
##
## Adjustment method for multiple comparisons:   fdr
##                                      Test Stat          Obs     Std.Obs     Alter
## 1     Meanannualtemperature / Substrate    F  6.410698839 -0.36683516   greater
## 2   Temperaturediurnalrange / Substrate    F 50.233569237  1.00766022   greater
## 3    Temperatureseasonality / Substrate    F 85.285660031  1.31147743   greater
## 4       Annualprecipitation / Substrate    F 43.492941519  0.46684752   greater
## 5  Precipitationseasonality / Substrate    F 30.131391574  1.27132085   greater
## 6              canopyheight / Substrate    F 29.751880630  0.28593165   greater
## 7          Meanannualtemperature / Diet    F  7.639300763 -0.22354950   greater
## 8        Temperaturediurnalrange / Diet    F 18.845061053 -0.01654606   greater
## 9         Temperatureseasonality / Diet    F 36.379289368  0.39119512   greater
## 10           Annualprecipitation / Diet    F 28.928950284  0.26360302   greater
## 11      Precipitationseasonality / Diet    F  9.424026879 -0.13593150   greater
## 12                 canopyheight / Diet    F 20.939372904  0.07404897   greater
## 13       Meanannualtemperature / logIMI    r -0.005568087 -0.08627808 two-sided
```

```
## 14     Temperaturediurnalrange / logIMI    r  0.064417470  0.44765927 two-sided
## 15      Temperatureseasonality / logIMI    r  0.094150676  0.51794675 two-sided
## 16         Annualprecipitation / logIMI    r -0.043565897 -0.30160436 two-sided
## 17    Precipitationseasonality / logIMI    r  0.048848016  0.46454438 two-sided
## 18                canopyheight / logIMI    r  0.003032699 -0.05299210 two-sided
## 19      Meanannualtemperature / logMass    r  0.016106652  0.14699254 two-sided
## 20    Temperaturediurnalrange / logMass    r -0.006463904 -0.02539157 two-sided
## 21     Temperatureseasonality / logMass    r -0.049144025 -0.24825489 two-sided
## 22        Annualprecipitation / logMass    r  0.067226553  0.36208663 two-sided
## 23   Precipitationseasonality / logMass    r -0.076467365 -0.61317788 two-sided
## 24               canopyheight / logMass    r  0.109690946  0.65975904 two-sided
## 25        Meanannualtemperature / logGr    r -0.152629999 -1.24669581 two-sided
## 26      Temperaturediurnalrange / logGr    r  0.111775473  0.67160417 two-sided
## 27       Temperatureseasonality / logGr    r  0.223557517  1.10607722 two-sided
## 28          Annualprecipitation / logGr    r -0.110655100 -0.60916409 two-sided
## 29     Precipitationseasonality / logGr    r  0.059958276  0.51560710 two-sided
## 30                canopyheight / logGr    r -0.087442802 -0.54784088 two-sided
## 31        Meanannualtemperature / logBR    r  0.021808518  0.09396304 two-sided
## 32      Temperaturediurnalrange / logBR    r -0.193595308 -1.09654199 two-sided
## 33       Temperatureseasonality / logBR    r -0.194171675 -0.91903159 two-sided
## 34          Annualprecipitation / logBR    r  0.248154755  1.29050516 two-sided
## 35     Precipitationseasonality / logBR    r -0.207096924 -1.60305740 two-sided
## 36                canopyheight / logBR    r  0.270723203  1.55723040 two-sided
## 37      Meanannualtemperature / logDimo    r  0.035611907  0.28566985 two-sided
## 38    Temperaturediurnalrange / logDimo    r -0.160718994 -0.94135511 two-sided
## 39     Temperatureseasonality / logDimo    r -0.219072582 -1.06315913 two-sided
## 40        Annualprecipitation / logDimo    r  0.183769939  0.98537658 two-sided
## 41   Precipitationseasonality / logDimo    r -0.158761670 -1.28755237 two-sided
## 42               canopyheight / logDimo    r  0.130783075  0.78468946 two-sided
## 43       Meanannualtemperature / logIBI    r  0.041429572  0.32331476 two-sided
## 44     Temperaturediurnalrange / logIBI    r -0.224151644 -1.29204313 two-sided
## 45      Temperatureseasonality / logIBI    r -0.248286478 -1.19584064 two-sided
## 46         Annualprecipitation / logIBI    r  0.271749959  1.43209768 two-sided
## 47    Precipitationseasonality / logIBI    r -0.255089819 -2.03648016 two-sided
## 48               canopyheight / logIBI    r  0.293942432  1.72771560 two-sided
## 49        Meanannualtemperature / logHR    r  0.026659309  0.21237943 two-sided
## 50      Temperaturediurnalrange / logHR    r  0.076493359  0.47695807 two-sided
## 51       Temperatureseasonality / logHR    r  0.102494184  0.51506578 two-sided
## 52          Annualprecipitation / logHR    r -0.050858421 -0.29859125 two-sided
## 53     Precipitationseasonality / logHR    r  0.085655934  0.72368880 two-sided
## 54                canopyheight / logHR    r -0.026476564 -0.18731901 two-sided
## 55       Meanannualtemperature / logDJL    r -0.111280539 -0.99154207 two-sided
## 56     Temperaturediurnalrange / logDJL    r  0.213362633  1.36772856 two-sided
## 57      Temperatureseasonality / logDJL    r  0.304628300  1.60297814 two-sided
## 58         Annualprecipitation / logDJL    r -0.236917326 -1.38151419 two-sided
## 59    Precipitationseasonality / logDJL    r  0.171681632  1.47341702 two-sided
## 60                canopyheight / logDJL    r -0.202595268 -1.32112745 two-sided
##    Pvalue Pvalue.adj
## 1  0.4562    0.81106
## 2  0.1756    0.79076
## 3  0.1254    0.79076
## 4  0.2698    0.79076
## 5  0.1302    0.79076
## 6  0.2728    0.79076
```

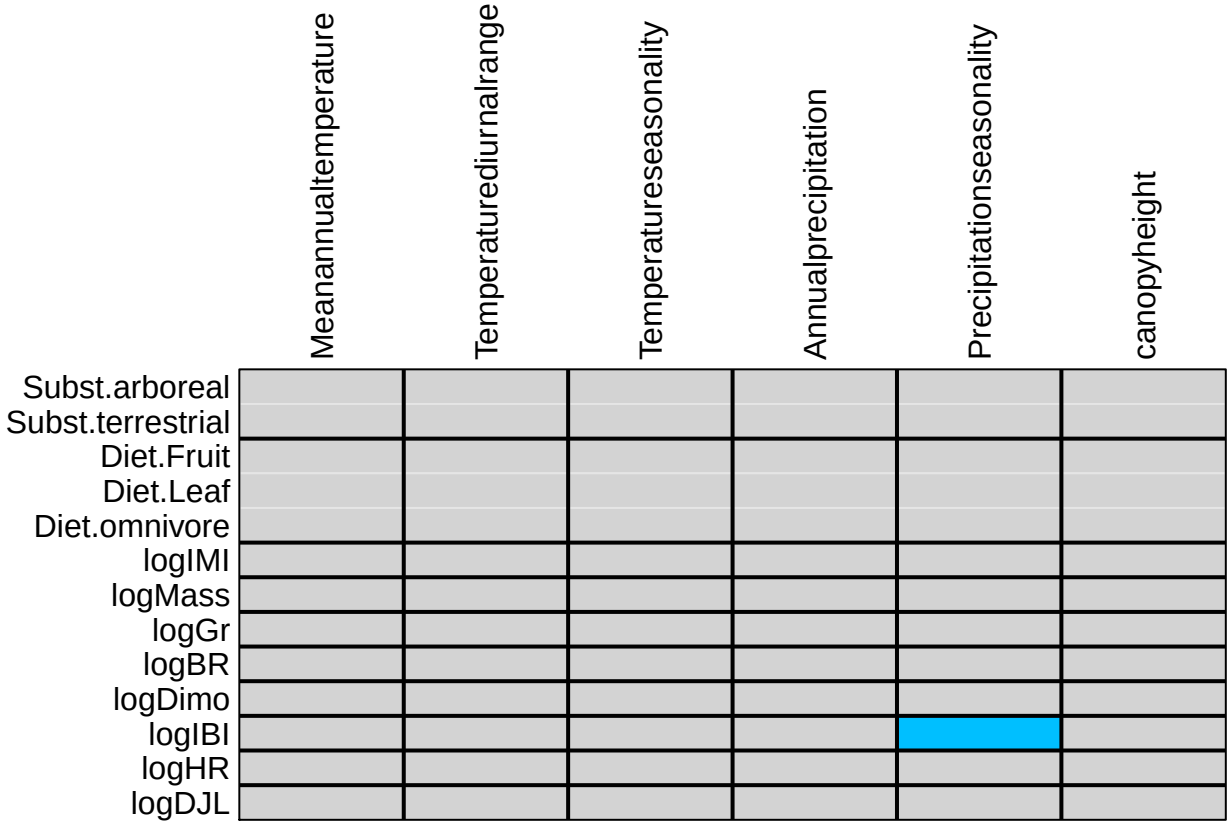
```
## 7  0.4798    0.82251
## 8  0.4240    0.81106
## 9  0.3216    0.79076
## 10 0.3508    0.79076
## 11 0.4482    0.81106
## 12 0.3754    0.79076
## 13 0.9422    0.97469
## 14 0.6954    0.88774
## 15 0.6544    0.87253
## 16 0.7952    0.91754
## 17 0.6804    0.88748
## 18 0.9640    0.98034
## 19 0.9042    0.96879
## 20 0.9812    0.98120
## 21 0.8214    0.92705
## 22 0.7374    0.91754
## 23 0.5832    0.87253
## 24 0.5598    0.87046
## 25 0.2530    0.79076
## 26 0.5332    0.86465
## 27 0.3324    0.79076
## 28 0.5658    0.87046
## 29 0.6260    0.87253
## 30 0.6090    0.87253
## 31 0.9234    0.97200
## 32 0.3160    0.79076
## 33 0.3978    0.79560
## 34 0.2168    0.79076
## 35 0.0852    0.79076
## 36 0.1010    0.79076
## 37 0.7880    0.91754
## 38 0.3822    0.79076
## 39 0.3358    0.79076
## 40 0.3632    0.79076
## 41 0.2112    0.79076
## 42 0.4596    0.81106
## 43 0.7926    0.91754
## 44 0.2152    0.79076
## 45 0.2668    0.79076
## 46 0.1548    0.79076
## 47 0.0246    0.79076
## 48 0.0676    0.79076
## 49 0.8394    0.92705
## 50 0.6458    0.87253
## 51 0.6256    0.87253
## 52 0.7674    0.91754
## 53 0.4944    0.82400
## 54 0.8498    0.92705
## 55 0.3736    0.79076
## 56 0.1886    0.79076
## 57 0.0994    0.79076
## 58 0.1746    0.79076
## 59 0.1468    0.79076
## 60 0.1992    0.79076
```

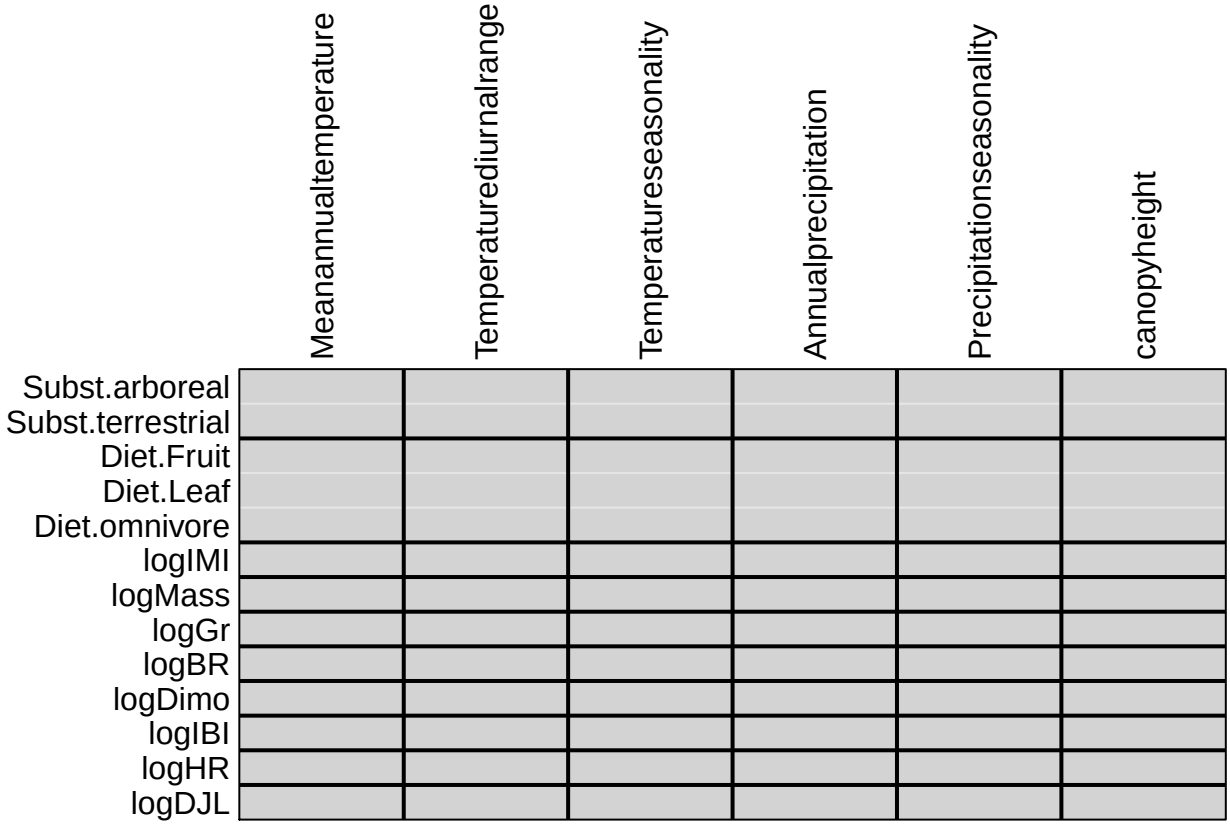
```
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## class: krandtest lightkrandtest
## Monte-Carlo tests
## Call: randtest.rlq(xtest = rlq.genus, nrepet = nrepet, modeltype = 6)
##
## Number of tests:   2
##
## Adjustment method for multiple comparisons:   none
## Permutation number:   4999
##      Test      Obs    Std.Obs   Alter Pvalue
## 1 Model 2 1.854111 64.5797643 greater 0.0002
## 2 Model 4 1.854111  0.2060271 greater 0.3614
## Monte-Carlo test
## Call: fourthcorner2(tabR = env, tabL = genus, tabQ = traits.genus2,
##     modeltype = 6, nrepet = nrepet, p.adjust.method.G = "fdr")
##
## Observation: 1.854111
##
## Based on 4999 replicates
## Simulated p-value: 0.3534
## Alternative hypothesis: greater
##
##     Std.Obs Expectation    Variance
##   0.2262734   1.6809440   0.5856828
## Fourth-corner Statistics
## -------------------------
## Permutation method  Comb. 2 and 4  ( 4999  permutations)
##
## Adjustment method for multiple comparisons:   fdr
## call:  fourthcorner.rlq(xtest = rlq.genus, nrepet = nrepet, modeltype = 6,      typetest = "Q.axes",
##
## ---
##
##                          Test   Stat          Obs    Std.Obs     Alter
## 1     AxcR1 / Subst.arboreal Homog.  0.236518355 -0.7945496      less
## 2     AxcR2 / Subst.arboreal Homog.  0.250382203 -0.6344809      less
## 3  AxcR1 / Subst.terrestrial Homog.  0.654509587  1.5930725      less
## 4  AxcR2 / Subst.terrestrial Homog.  0.747527152  5.9877031      less
## 5         AxcR1 / Diet.Fruit Homog.  0.017979621 -0.4306750      less
## 6         AxcR2 / Diet.Fruit Homog.  0.024722585 -0.3258973      less
## 7          AxcR1 / Diet.Leaf Homog.  0.121898825 -1.0391495      less
## 8          AxcR2 / Diet.Leaf Homog.  0.140421393 -0.8224823      less
## 9      AxcR1 / Diet.omnivore Homog.  0.753945326  0.9929585      less
## 10     AxcR2 / Diet.omnivore Homog.  0.830466698  4.1516264      less
## 11            AxcR1 / logIMI      r -0.066089726 -0.3499488 two-sided
## 12            AxcR2 / logIMI      r -0.038742153 -0.2447231 two-sided
## 13           AxcR1 / logMass      r  0.079475457  0.3751313 two-sided
## 14           AxcR2 / logMass      r -0.056221525 -0.3110667 two-sided
## 15             AxcR1 / logGr      r -0.173532927 -0.7849473 two-sided
## 16             AxcR2 / logGr      r -0.138905153 -0.7248848 two-sided
## 17             AxcR1 / logBR      r  0.284945601  1.2875086 two-sided
## 18             AxcR2 / logBR      r -0.116516490 -0.7823156 two-sided
```

```
## 19           AxcR1 / logDimo      r  0.224105611  1.0032072 two-sided
## 20           AxcR2 / logDimo      r  0.003234064  0.1135775 two-sided
## 21            AxcR1 / logIBI      r  0.332944934  1.5006162 two-sided
## 22            AxcR2 / logIBI      r -0.104621552 -0.6044541 two-sided
## 23             AxcR1 / logHR      r -0.085548311 -0.3978772 two-sided
## 24             AxcR2 / logHR      r  0.003126435  0.1348599 two-sided
## 25            AxcR1 / logDJL      r -0.304664558 -1.4924872 two-sided
## 26            AxcR2 / logDJL      r -0.048883351 -0.3175891 two-sided
##               Pvalue Pvalue.adj
## 1             0.3088    0.89505
## 2             0.3088    0.89505
## 3             0.9392          1
## 4                  1          1
## 5  0.536259952657629    0.89505
## 6  0.765655261459006    0.89505
## 7             0.2464    0.89505
## 8             0.3916    0.89505
## 9             0.7866    0.89505
## 10                 1          1
## 11             0.762    0.89505
## 12            0.8262    0.89505
## 13            0.7252    0.89505
## 14            0.7698    0.89505
## 15            0.4752    0.89505
## 16            0.5004    0.89505
## 17             0.229    0.89505
## 18            0.4858    0.89505
## 19            0.3728    0.89505
## 20            0.9112          1
## 21            0.1296    0.89505
## 22            0.6218    0.89505
## 23            0.7028    0.89505
## 24            0.8984          1
## 25            0.1344    0.89505
## 26             0.794    0.89505
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Fourth-corner Statistics
## ------------------------
## Permutation method  Comb. 2 and 4  ( 4999  permutations)
##
## Adjustment method for multiple comparisons:   fdr
## call:  fourthcorner.rlq(xtest = rlq.genus, nrepet = nrepet, modeltype = 6,      typetest = "R.axes",
##
## ---
##
##                                Test Stat          Obs    Std.Obs     Alter
## 1     Meanannualtemperature / AxcQ1    r  0.128610183  1.0723417 two-sided
## 2   Temperaturediurnalrange / AxcQ1    r -0.323655270 -1.9571823 two-sided
## 3    Temperatureseasonality / AxcQ1    r -0.419469813 -2.1055814 two-sided
## 4       Annualprecipitation / AxcQ1    r  0.366527936  2.0173158 two-sided
## 5  Precipitationseasonality / AxcQ1    r -0.291535942 -2.4221448 two-sided
## 6              canopyheight / AxcQ1    r  0.335646315  2.0651656 two-sided
```

```
## 7     Meanannualtemperature / AxcQ2    r  0.074961722  0.7387254 two-sided
## 8   Temperaturediurnalrange / AxcQ2    r -0.008334555 -0.1440738 two-sided
## 9    Temperatureseasonality / AxcQ2    r -0.076112212 -0.4827966 two-sided
## 10      Annualprecipitation / AxcQ2    r -0.023476730 -0.0398192 two-sided
## 11 Precipitationseasonality / AxcQ2    r  0.045379735  0.3030314 two-sided
## 12             canopyheight / AxcQ2    r -0.066827599 -0.3256431 two-sided
##    Pvalue        Pvalue.adj
## 1  0.3216            0.6432
## 2  0.0364           0.08736 .
## 3  0.0122            0.0732 .
## 4  0.0294           0.08736 .
## 5  0.0086            0.0732 .
## 6  0.0282           0.08736 .
## 7  0.5076 0.870171428571429
## 8  0.8988            0.9734
## 9  0.6576           0.94008
## 10 0.9734            0.9734
## 11 0.7834           0.94008
## 12 0.7708           0.94008
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

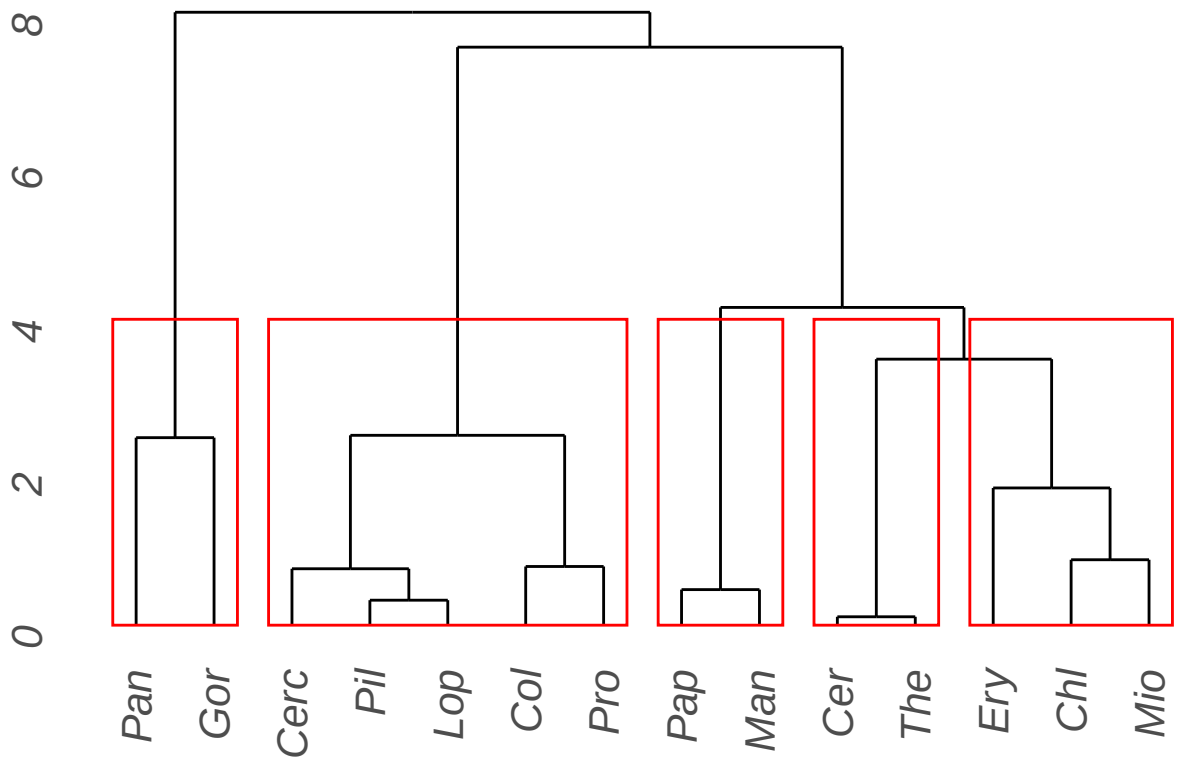
Tables showing significant assoications between environmental variables and genus traits from fourth corner.

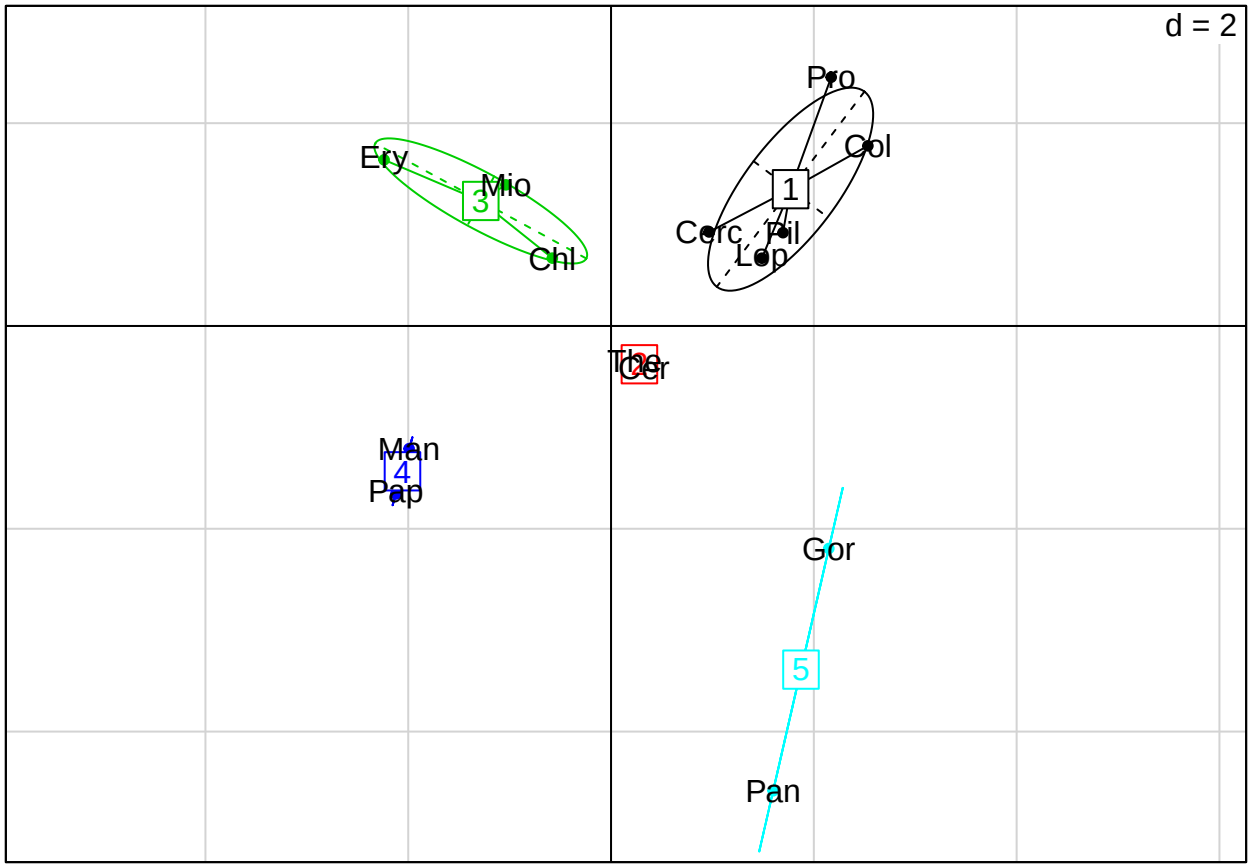




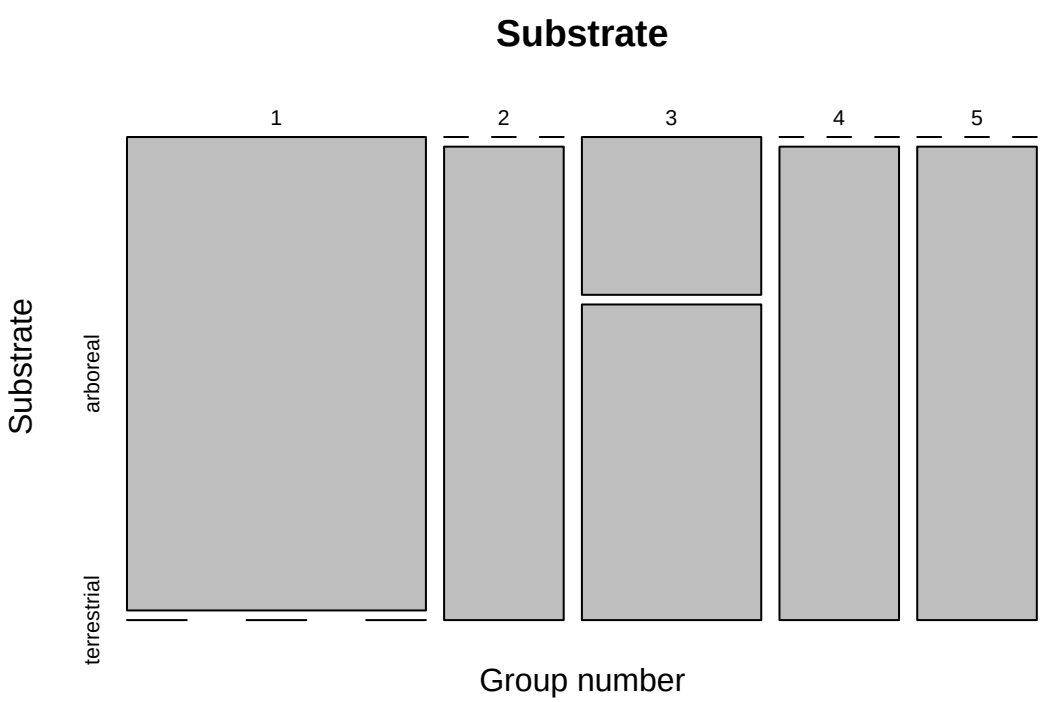
Hierarchical cluster analysis on trait scores

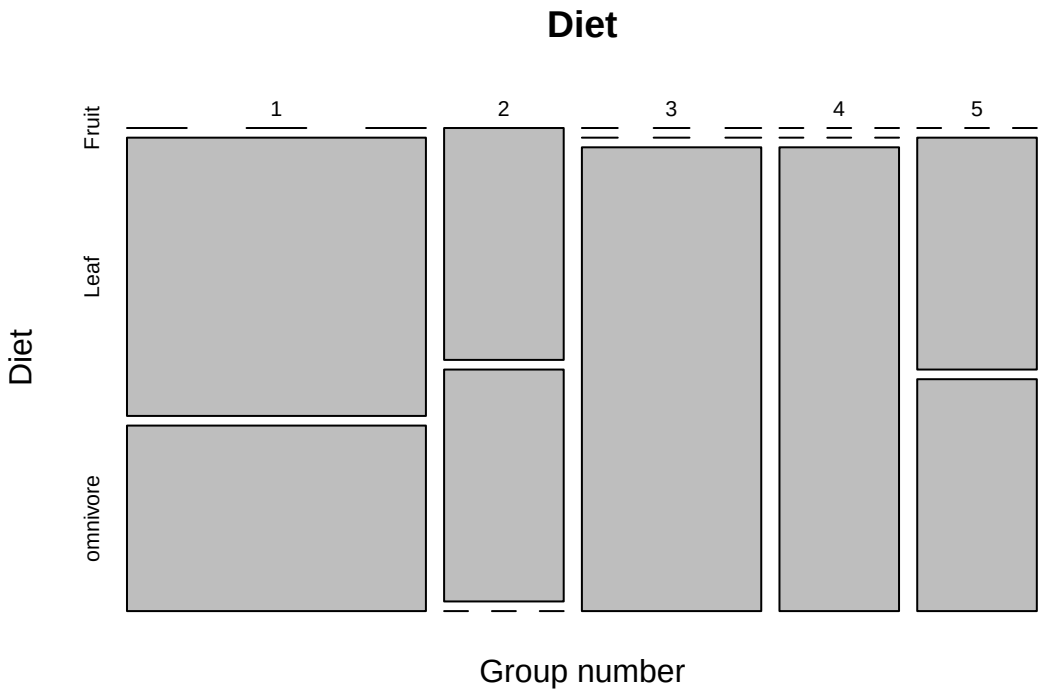
Cluster dendrogram showing genus groups, and ordination plot showing group clusters in the RLQ matrix.

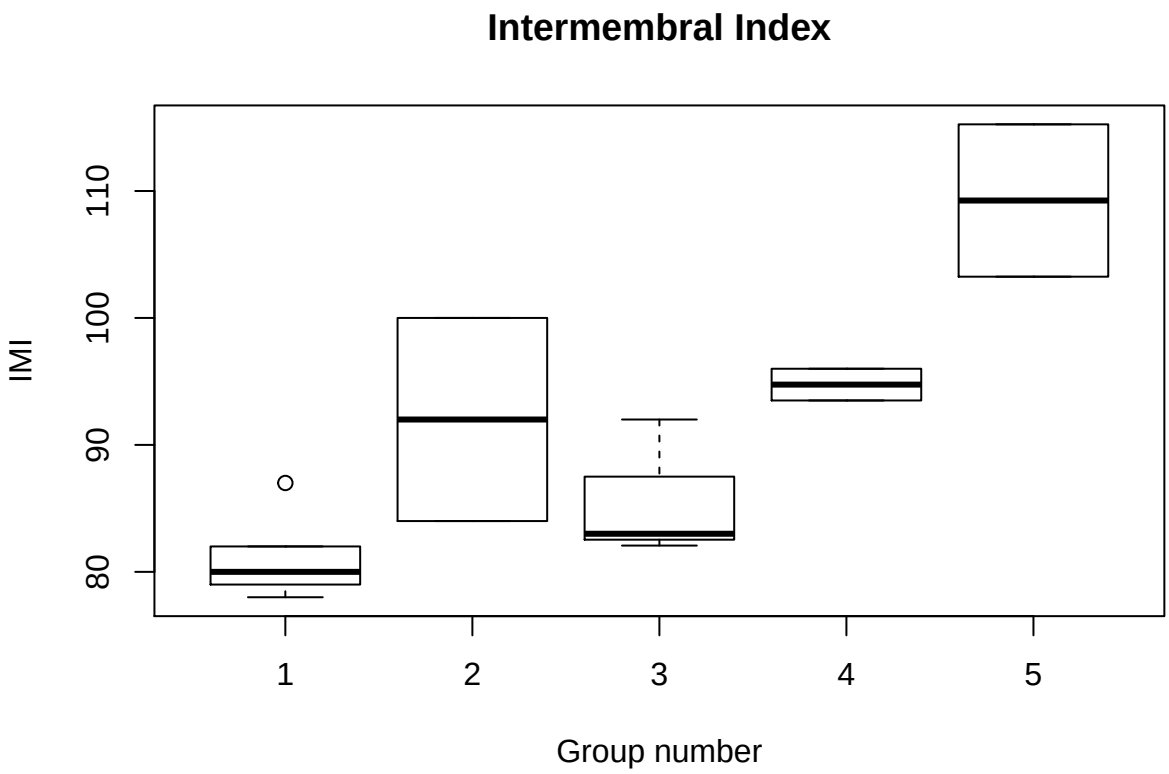

0
2
4
6
8
Pan
Gor
Cerc
Pil
Lop
Col
Pro
Pap
Man
Cer
The
Ery
Chl
Mio

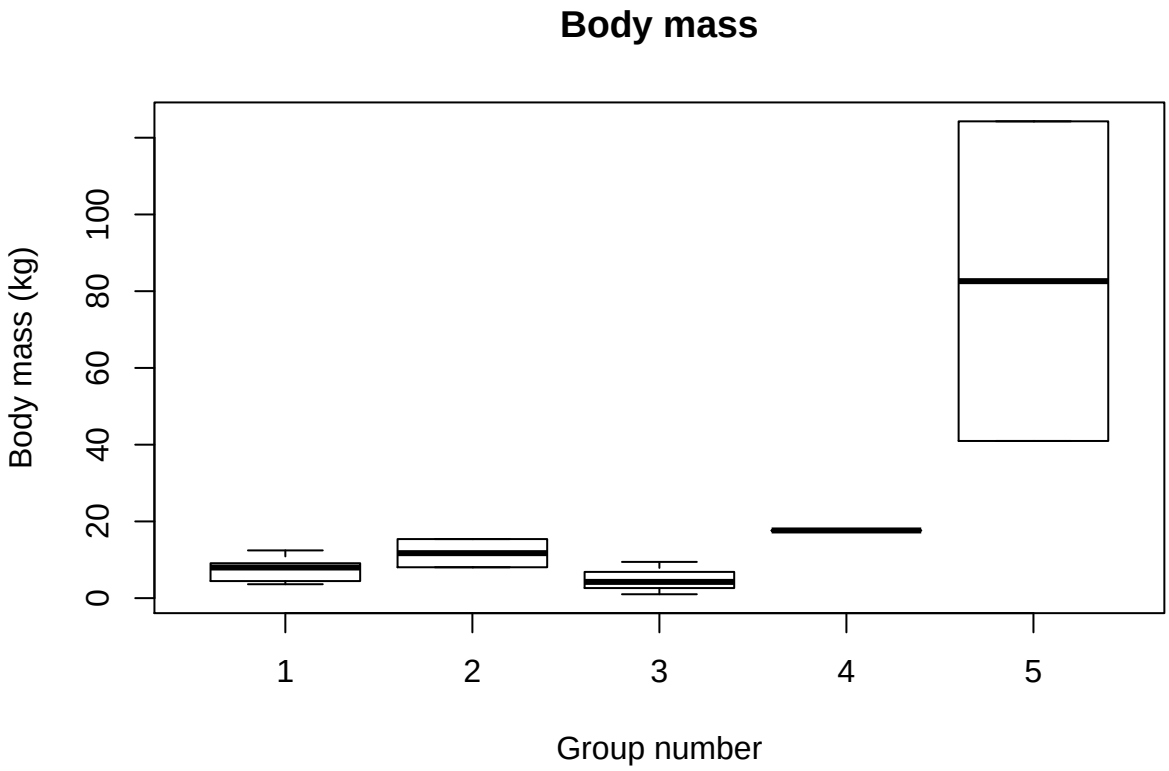


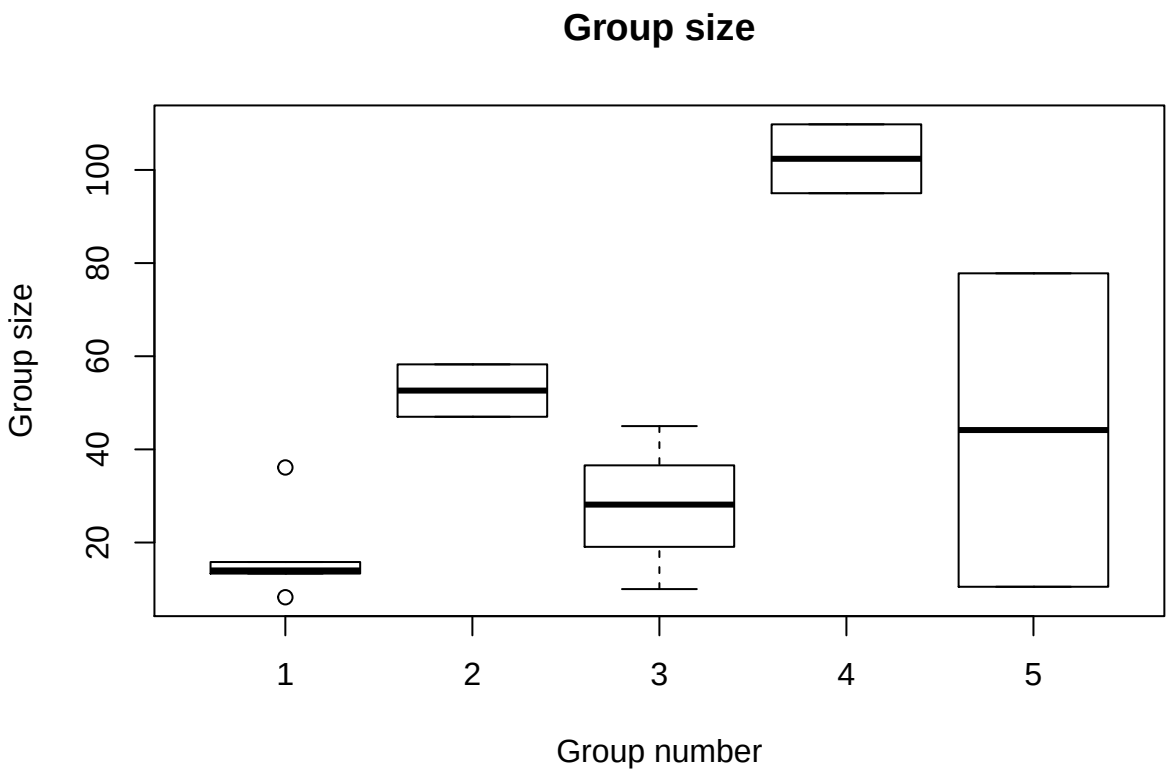
Plots of traits by functional groups.

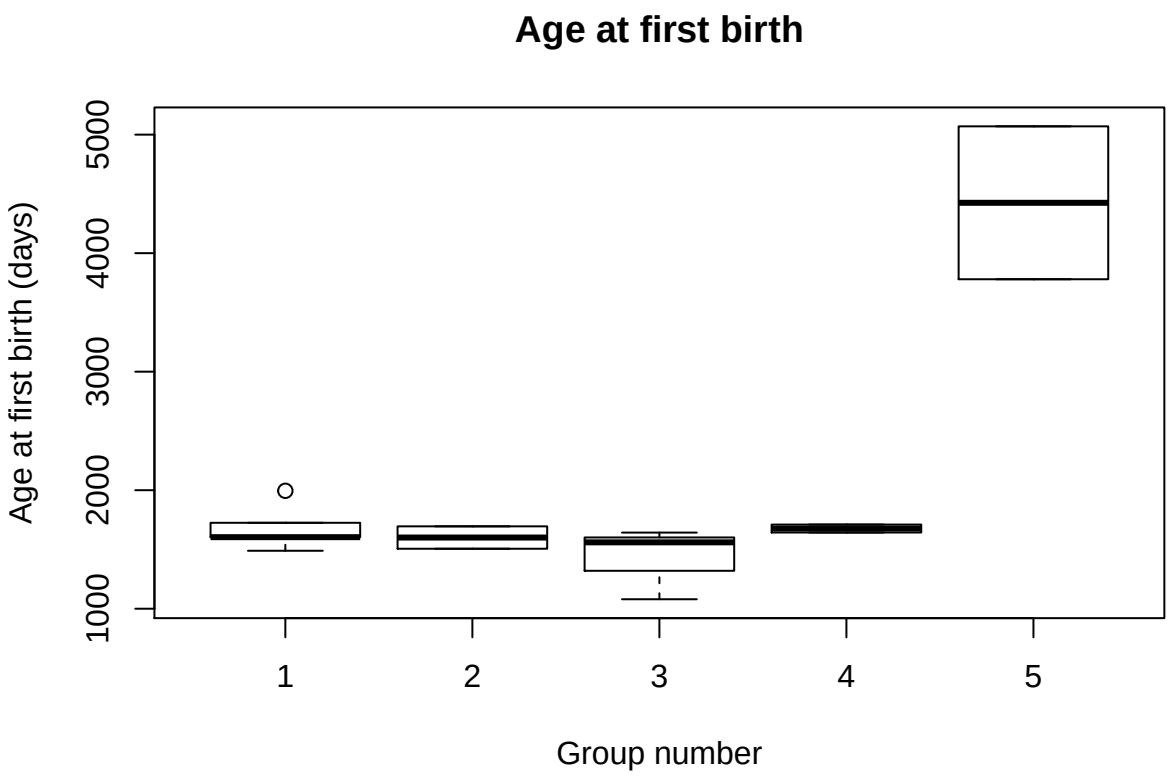

Substrate
1
2
3
4
5
Substrate
arboreal
terrestrial
Group number

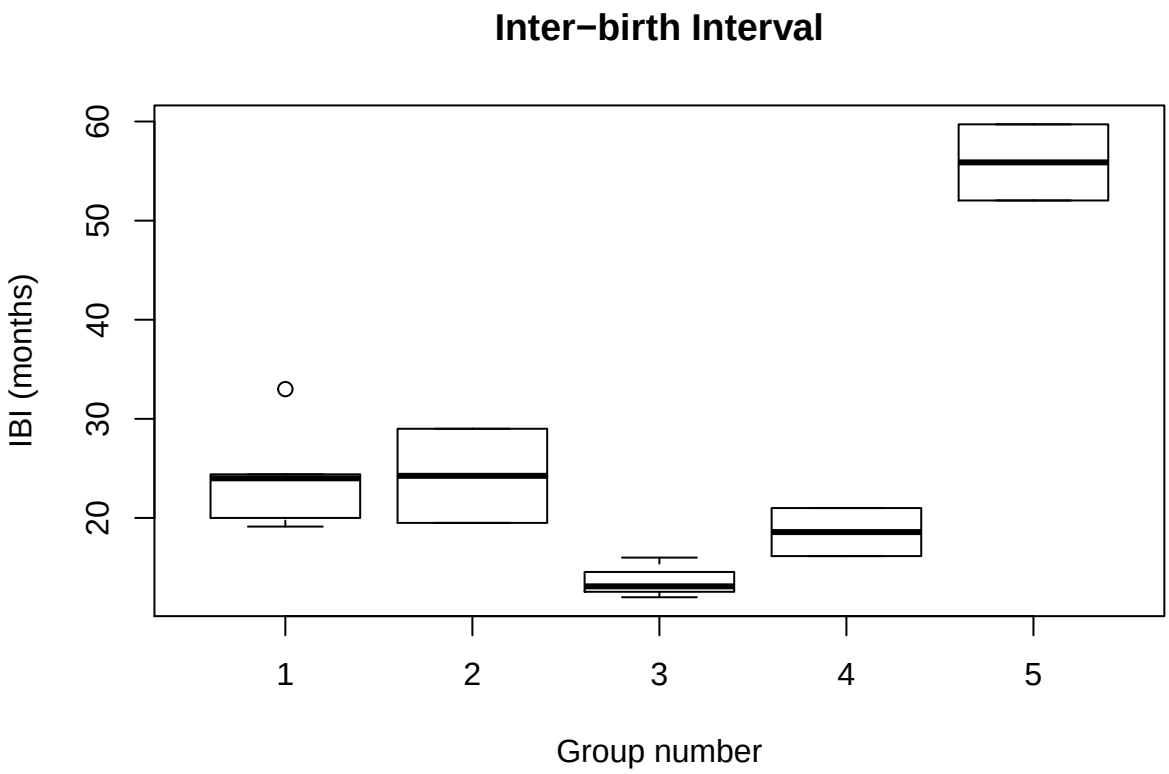

Diet
1
2
3
4
5
Fruit
Leaf
omnivore
Diet
Group number

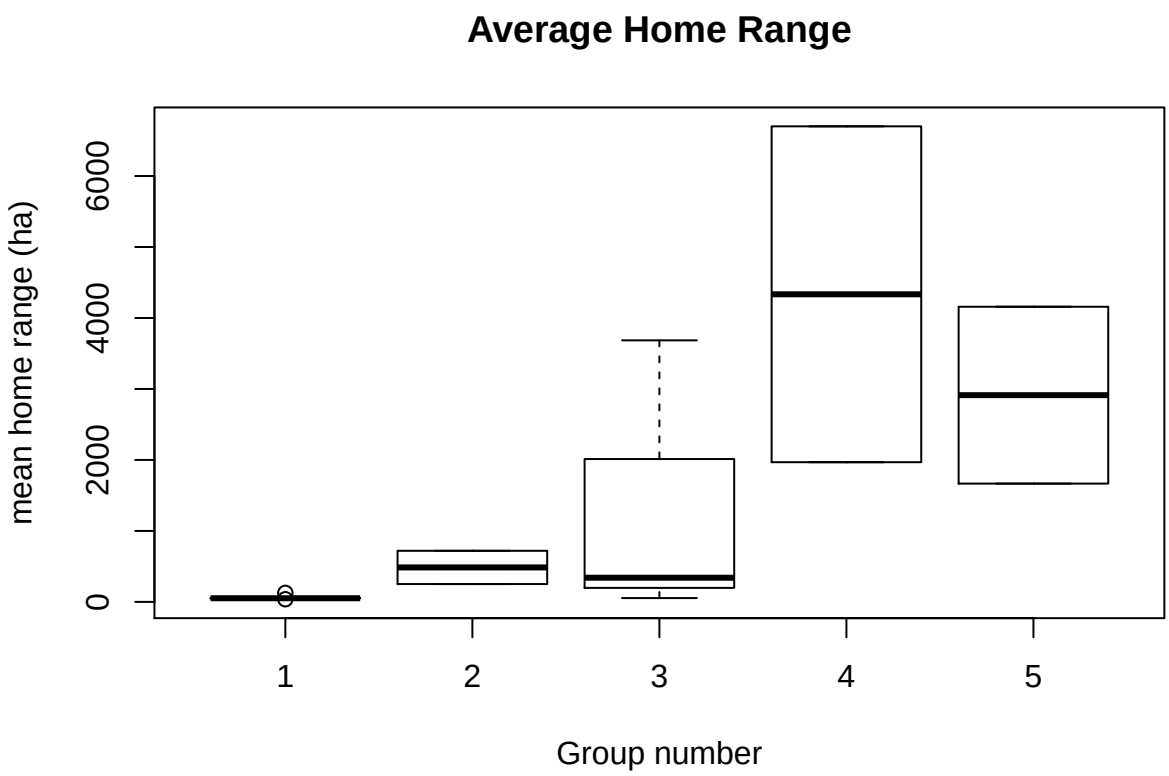

Intermembral Index
IMI
80
90
100
110
1
2
3
4
5
Group number

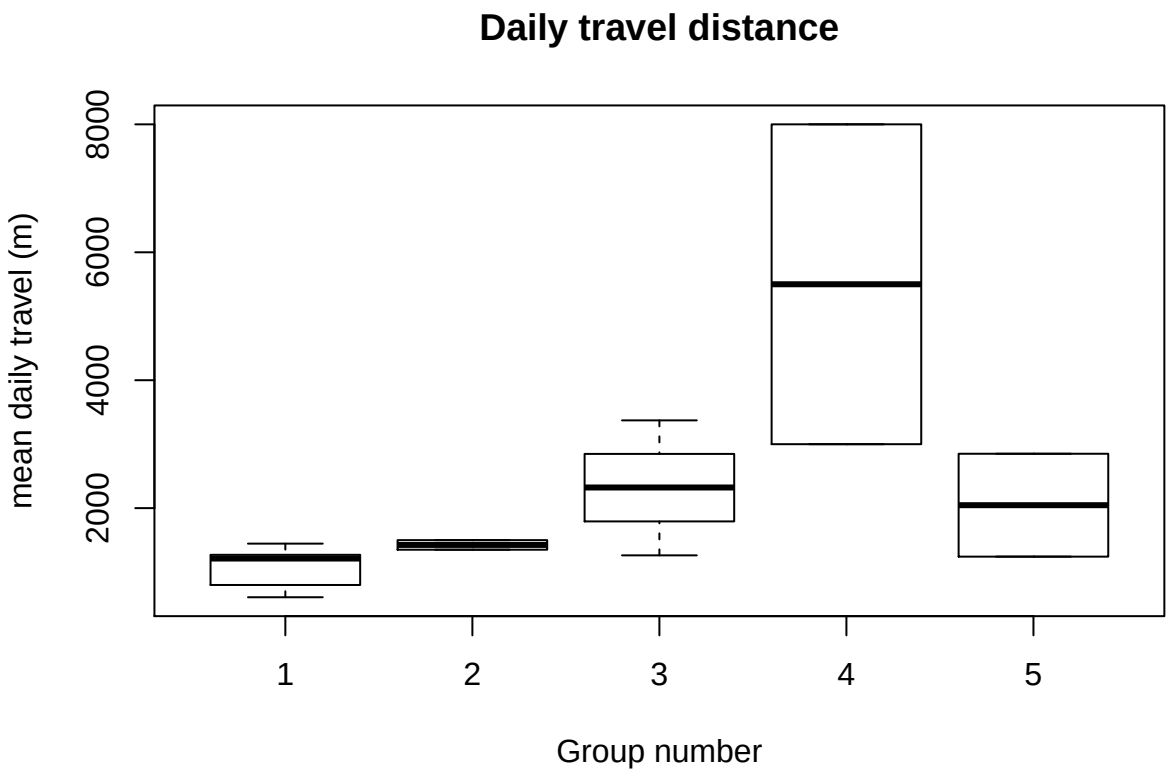

Body mass
Body mass (kg)
0
20
40
60
80
100
1
2
3
4
5
Group number


Group size
Group size
20
40
60
80
100
1
2
3
4
5
Group number


Age at first birth
Age at first birth (days)
1000
2000
3000
4000
5000
1
2
3
4
5
Group number


Inter−birth Interval
IBI (months)
20
30
40
50
60
1
2
3
4
5
Group number


Average Home Range
mean home range (ha)
0
2000
4000
6000
1
2
3
4
5
Group number



Species level analysis

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
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## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

RLQ analysis results

Summary output of the RLQ analysis, including decomposition of inertia (contributions of individual variables to total model inertia and to the first two RLQ axes)

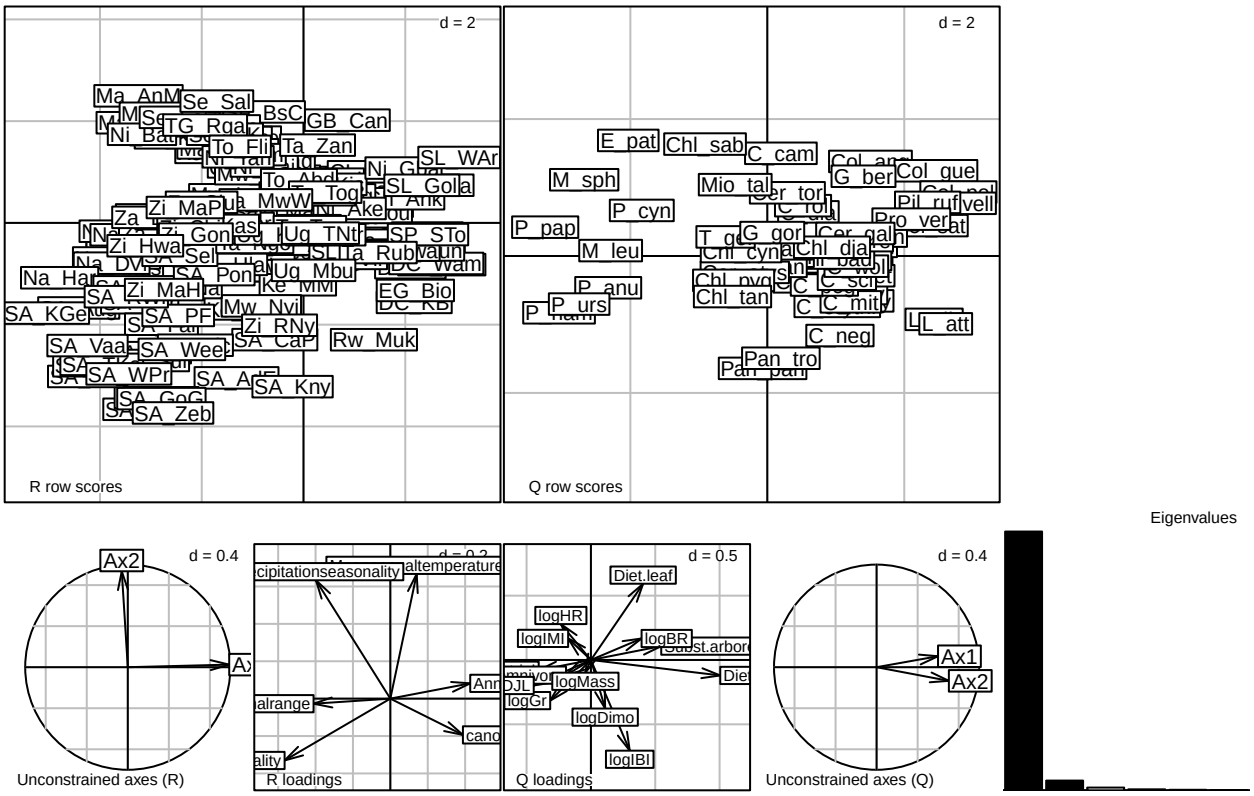
```
## RLQ analysis
##
## Class: rlq dudi
## Call: rlq(dudiR = acpR.species, dudiL = afcL.species, dudiQ = acpQ.species,
##     scannf = FALSE)
##
## Total inertia: 1.836
```

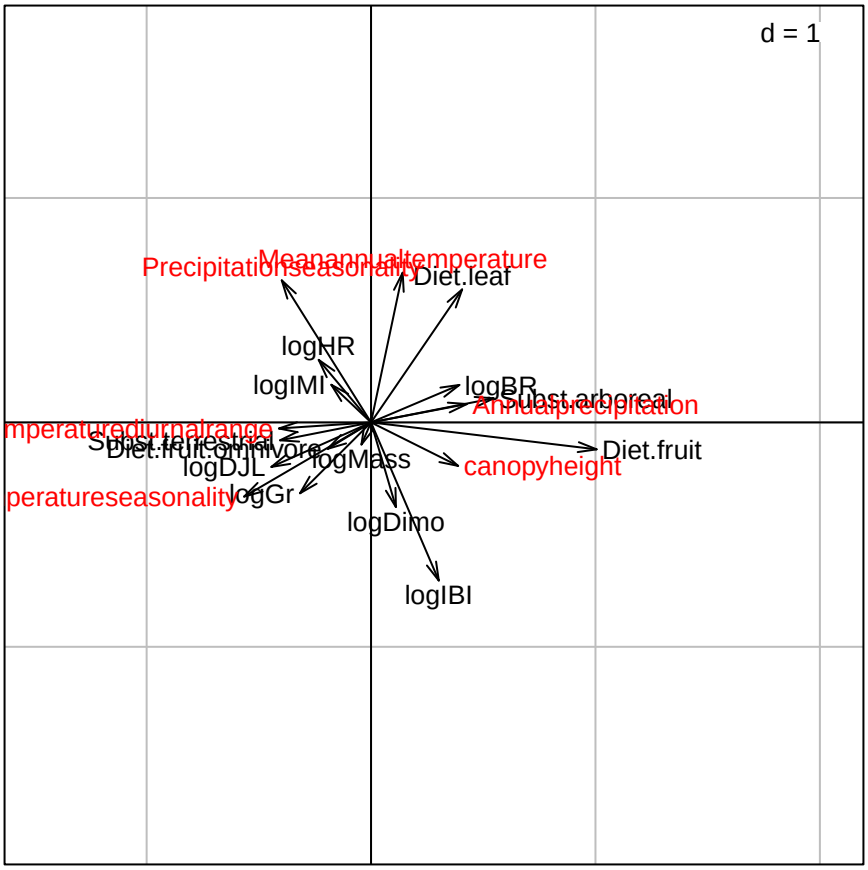
```
##
## Eigenvalues:
##      Ax1      Ax2      Ax3      Ax4      Ax5
## 1.740075 0.065448 0.018417 0.006682 0.003531
##
## Projected inertia (%):
##     Ax1     Ax2     Ax3     Ax4     Ax5
## 94.7972  3.5655  1.0033  0.3640  0.1924
##
## Cumulative projected inertia (%):
##     Ax1   Ax1:2   Ax1:3   Ax1:4   Ax1:5
##   94.80   98.36   99.37   99.73   99.92
##
## (Only 5 dimensions (out of 6) are shown)
##
##
## Eigenvalues decomposition:
##          eig     covar      sdR       sdQ      corr
## 1 1.74007515 1.3191191 1.720209 1.6630801 0.4610941
## 2 0.06544837 0.2558288 1.071625 0.8676169 0.2751557
##
## Inertia & coinertia R (acpR.species):
##    inertia      max     ratio
## 1  2.95912 3.013394 0.9819892
## 12 4.10750 4.271873 0.9615222
##
## Inertia & coinertia Q (acpQ.species):
##     inertia      max     ratio
## 1  2.765835 4.524195 0.6113432
## 12 3.518594 6.564118 0.5360346
##
## Correlation L (afcL.species):
##        corr       max     ratio
## 1 0.4610941 0.9154770 0.5036654
## 2 0.2751557 0.8243545 0.3337832
## Inertia information:
## Call: inertia.dudi(x = rlq.species, row.inertia = TRUE, col.inertia = TRUE)
##
## Decomposition of total inertia:
##      inertia     cum  cum(%)
## Ax1 1.740075   1.740   94.80
## Ax2 0.065448   1.806   98.36
## Ax3 0.018417   1.824   99.37
## Ax4 0.006682   1.831   99.73
## Ax5 0.003531   1.834   99.92
## Ax6 0.001424   1.836  100.00
##
## Row contributions (%):
##    Meanannualtemperature  Temperaturediurnalrange   Temperatureseasonality
##                    3.574                  16.117                   31.125
##      Annualprecipitation Precipitationseasonality              canopyheight
##                   17.602                  16.584                   14.997
##
## Row absolute contributions (%):
```

```
##                            Axis1    Axis2
## Meanannualtemperature      1.987 44.49375
## Temperaturediurnalrange   16.861  0.07341
## Temperatureseasonality    32.001 10.93027
## Annualprecipitation       18.252  0.66894
## Precipitationseasonality  15.828 40.07432
## canopyheight              15.070  3.75931
##
## Signed row relative contributions:
##                            Axis1    Axis2
## Meanannualtemperature      52.71 44.38883
## Temperaturediurnalrange   -99.17 -0.01624
## Temperatureseasonality    -97.47 -1.25214
## Annualprecipitation        98.30  0.13550
## Precipitationseasonality  -90.48  8.61570
## canopyheight               95.26 -0.89376
##
## Cumulative sum of row relative contributions (%):
##                            Axis1 Axis1:2 Axis3:6
## Meanannualtemperature      52.71   97.10  2.8989
## Temperaturediurnalrange    99.17   99.19  0.8104
## Temperatureseasonality     97.47   98.72  1.2824
## Annualprecipitation        98.30   98.43  1.5681
## Precipitationseasonality   90.48   99.09  0.9084
## canopyheight               95.26   96.15  3.8489
##
## Column contributions (%):
##      Subst.arboreal   Subst.terrestrial          Diet.fruit Diet.fruit.omnivore
##             12.1407              9.0101              7.7602              2.7149
##           Diet.leaf              logIMI             logMass               logGr
##              2.9396              3.2257              0.3418              9.9394
##               logBR             logDimo              logIBI               logHR
##             15.0399              1.9003             10.4881              5.6139
##              logDJL
##             18.8854
##
## Column absolute contributions (%):
##                        Axis1   Axis2
## Subst.arboreal        12.725  0.4926
## Subst.terrestrial      9.444  0.3656
## Diet.fruit             7.906  0.1128
## Diet.fruit.omnivore    2.823  1.0483
## Diet.leaf              2.737  5.8307
## logIMI                 3.135  2.8160
## logMass                0.183  0.9726
## logGr                 10.014  9.9706
## logBR                 15.506  2.7874
## logDimo                1.228 14.2293
## logIBI                 9.113 49.6696
## logHR                  5.443  7.7721
## logDJL                19.743  3.9325
##
## Signed column relative contributions:
##                        Axis1     Axis2
```

```
## Subst.arboreal        99.36   0.14466
## Subst.terrestrial    -99.36  -0.14466
## Diet.fruit            96.57  -0.05182
## Diet.fruit.omnivore  -98.56  -1.37680
## Diet.leaf             88.26   7.07217
## logIMI               -92.12   3.11276
## logMass              -50.76 -10.14619
## logGr                -95.51  -3.57675
## logBR                 97.73   0.66081
## logDimo               61.28 -26.69898
## logIBI                82.37 -16.88566
## logHR                -91.92   4.93623
## logDJL               -99.10  -0.74246
##
## Cumulative sum of column relative contributions (%):
##                       Axis1 Axis1:2  Axis3:6
## Subst.arboreal        99.36   99.51  0.49346
## Subst.terrestrial     99.36   99.51  0.49346
## Diet.fruit            96.57   96.62  3.37503
## Diet.fruit.omnivore   98.56   99.94  0.06445
## Diet.leaf             88.26   95.33  4.67108
## logIMI                92.12   95.24  4.76376
## logMass               50.76   60.91 39.09007
## logGr                 95.51   99.08  0.91617
## logBR                 97.73   98.40  1.60460
## logDimo               61.28   87.98 12.02063
## logIBI                82.37   99.26  0.74345
## logHR                 91.92   96.85  3.14502
## logDJL                99.10   99.84  0.15534
```

Plot summaries of RLQ analysis showing scores of sites, species, biological traits and environmental variables in the RLQ matrix.


d = 2
R row scores
d = 2
Q row scores
Eigenvalues
d = 0.4
Ax2
Unconstrained axes (R)
d = 0.2
R loadings
d = 0.5
Q loadings
d = 0.4
Ax1
Ax2
Unconstrained axes (Q)



Fourth corner test results

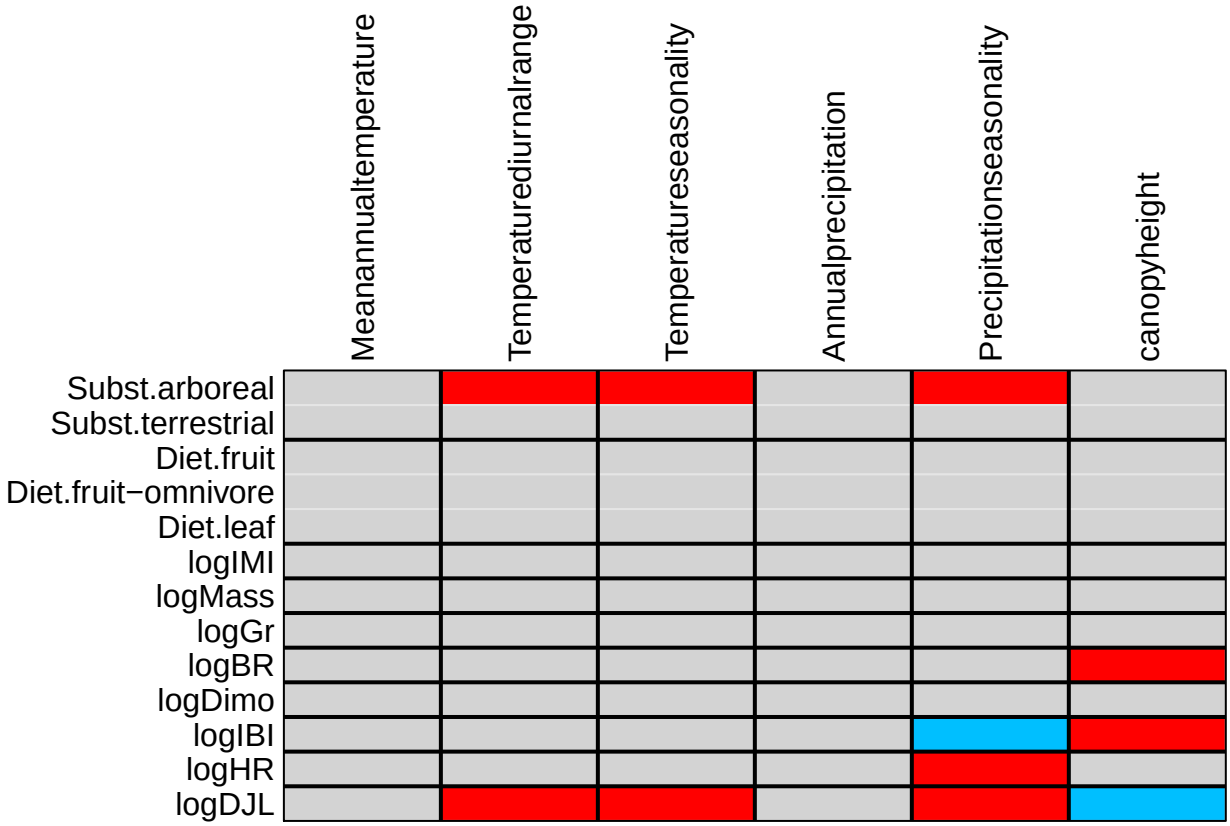
Summary output showing test results for species traits against environmental variables (Pseudo F for quantitative x qualitative and Pearson R for two quantitative variables).

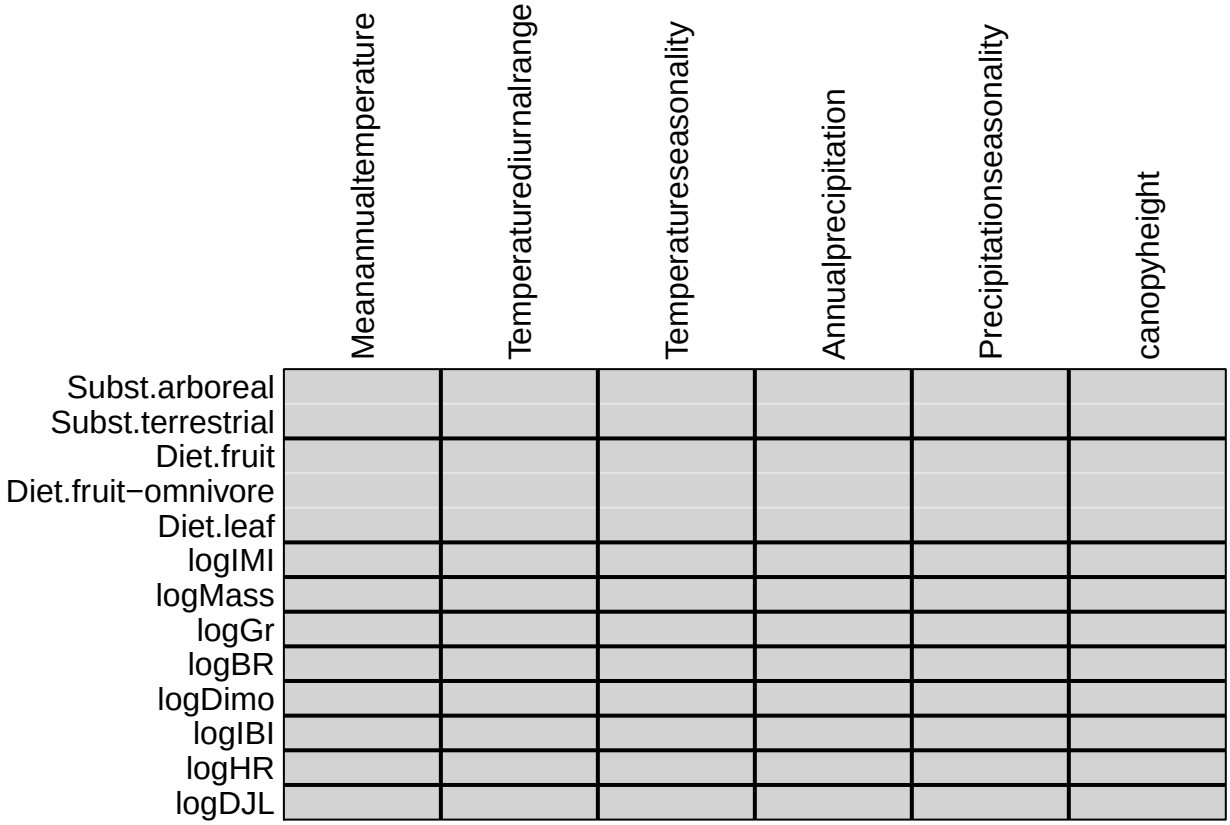
```
## class: krandtest lightkrandtest
## Monte-Carlo tests
## Call: randtest.rlq(xtest = rlq.species, nrepet = nrepet, modeltype = 6)
##
## Number of tests:   2
##
## Adjustment method for multiple comparisons:   none
## Permutation number:   4999
##      Test      Obs   Std.Obs   Alter Pvalue
## 1 Model 2 1.835577 66.173413 greater 0.0002
## 2 Model 4 1.835577  1.388626 greater 0.0862
## Monte-Carlo test
## Call: fourthcorner2(tabR = env, tabL = species, tabQ = traits.species2,
##     modeltype = 6, nrepet = nrepet, p.adjust.method.G = "fdr")
##
## Observation: 1.835577
##
## Based on 4999 replicates
## Simulated p-value: 0.0848
```

```
## Alternative hypothesis: greater
##
##     Std.Obs Expectation    Variance
##   1.4281812   1.0982419   0.2665408
## Fourth-corner Statistics
## -----------------------
## Permutation method  Comb. 2 and 4  ( 4999  permutations)
##
## Adjustment method for multiple comparisons:   fdr
## call:  fourthcorner.rlq(xtest = rlq.species, nrepet = nrepet, modeltype = 6,      typetest = "Q.axes
##
## ---
##
##                            Test   Stat         Obs    Std.Obs     Alter Pvalue
## 1       AxcR1 / Subst.arboreal Homog.  0.24001157 -1.6001227      less 0.1036
## 2       AxcR2 / Subst.arboreal Homog.  0.26891321 -1.1971967      less 0.1994
## 3    AxcR1 / Subst.terrestrial Homog.  0.62962481  2.7651479      less 0.9972
## 4    AxcR2 / Subst.terrestrial Homog.  0.73059773  5.9842729      less      1
## 5           AxcR1 / Diet.fruit Homog.  0.02273274 -0.7941174      less  0.153
## 6           AxcR2 / Diet.fruit Homog.  0.03849020 -0.5141163      less 0.4558
## 7  AxcR1 / Diet.fruit-omnivore Homog.  0.80414259  3.0067306      less 0.9982
## 8  AxcR2 / Diet.fruit-omnivore Homog.  0.82590239  3.3272728      less  0.999
## 9            AxcR1 / Diet.leaf Homog.  0.09394480 -0.6736501      less 0.3696
## 10           AxcR2 / Diet.leaf Homog.  0.13162265 -0.3155943      less 0.6132
## 11              AxcR1 / logIMI      r -0.13576851 -0.8204584 two-sided 0.4448
## 12              AxcR2 / logIMI      r  0.04006130  0.1749324 two-sided 0.9028
## 13             AxcR1 / logMass      r -0.03280697 -0.2272826 two-sided 0.8288
## 14             AxcR2 / logMass      r -0.02354394 -0.1667434 two-sided 0.8776
## 15               AxcR1 / logGr      r -0.24266227 -1.3563501 two-sided 0.1778
## 16               AxcR2 / logGr      r -0.07538192 -0.4029218 two-sided 0.7214
## 17               AxcR1 / logBR      r  0.30196127  1.7231321 two-sided 0.0968
## 18               AxcR2 / logBR      r  0.03985690  0.1898346 two-sided 0.8176
## 19             AxcR1 / logDimo      r  0.08499098  0.4853069 two-sided 0.6432
## 20             AxcR2 / logDimo      r -0.09005293 -0.4677054 two-sided  0.656
## 21              AxcR1 / logIBI      r  0.23149479  1.3035535 two-sided    0.2
## 22              AxcR2 / logIBI      r -0.16824873 -0.9228198 two-sided 0.3452
## 23               AxcR1 / logHR      r -0.17891256 -1.0114175 two-sided 0.3386
## 24               AxcR2 / logHR      r  0.06655409  0.3388731 two-sided 0.7946
## 25              AxcR1 / logDJL      r -0.34072947 -1.9562042 two-sided 0.0492
## 26              AxcR2 / logDJL      r -0.04734160 -0.2782786 two-sided 0.7742
##           Pvalue.adj
## 1  0.742857142857143
## 2  0.742857142857143
## 3                  1
## 4                  1
## 5  0.742857142857143
## 6             0.9028
## 7                  1
## 8                  1
## 9             0.9028
## 10            0.9028
## 11            0.9028
## 12            0.9028
## 13            0.9028
```

```
## 14            0.9028
## 15 0.742857142857143
## 16            0.9028
## 17 0.742857142857143
## 18            0.9028
## 19            0.9028
## 20            0.9028
## 21 0.742857142857143
## 22            0.9028
## 23            0.9028
## 24            0.9028
## 25 0.742857142857143
## 26            0.9028
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Fourth-corner Statistics
## -------------------------
## Permutation method  Comb. 2 and 4  ( 4999  permutations)
##
## Adjustment method for multiple comparisons:   fdr
## call:  fourthcorner.rlq(xtest = rlq.species, nrepet = nrepet, modeltype = 6,      typetest = "R.axes
##
## ---
##
##                                Test Stat          Obs     Std.Obs     Alter
## 1     Meanannualtemperature / AxcQ1    r  0.111816192  0.87787720 two-sided
## 2   Temperaturediurnalrange / AxcQ1    r -0.325697167 -2.90448957 two-sided
## 3    Temperatureseasonality / AxcQ1    r -0.448694432 -2.49657920 two-sided
## 4       Annualprecipitation / AxcQ1    r  0.338866689  2.51018878 two-sided
## 5  Precipitationseasonality / AxcQ1    r -0.315566209 -3.38695039 two-sided
## 6              canopyheight / AxcQ1    r  0.307913918  2.90946342 two-sided
## 7     Meanannualtemperature / AxcQ2    r  0.196684874  1.54965699 two-sided
## 8   Temperaturediurnalrange / AxcQ2    r -0.007989032 -0.09114559 two-sided
## 9    Temperatureseasonality / AxcQ2    r -0.097484814 -0.56547761 two-sided
## 10      Annualprecipitation / AxcQ2    r  0.024116575  0.19432144 two-sided
## 11 Precipitationseasonality / AxcQ2    r  0.186661394  2.02244952 two-sided
## 12             canopyheight / AxcQ2    r -0.057170937 -0.53115226 two-sided
##    Pvalue        Pvalue.adj
## 1  0.4032            0.6048
## 2   0.001             0.004 **
## 3  0.0094           0.02256  *
## 4   0.006             0.018  *
## 5   2e-04            0.0024 **
## 6   8e-04             0.004 **
## 7  0.1278 0.219085714285714
## 8  0.9294            0.9294
## 9  0.5992           0.73608
## 10  0.856            0.9294
## 11 0.0408            0.0816  .
## 12 0.6134           0.73608
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

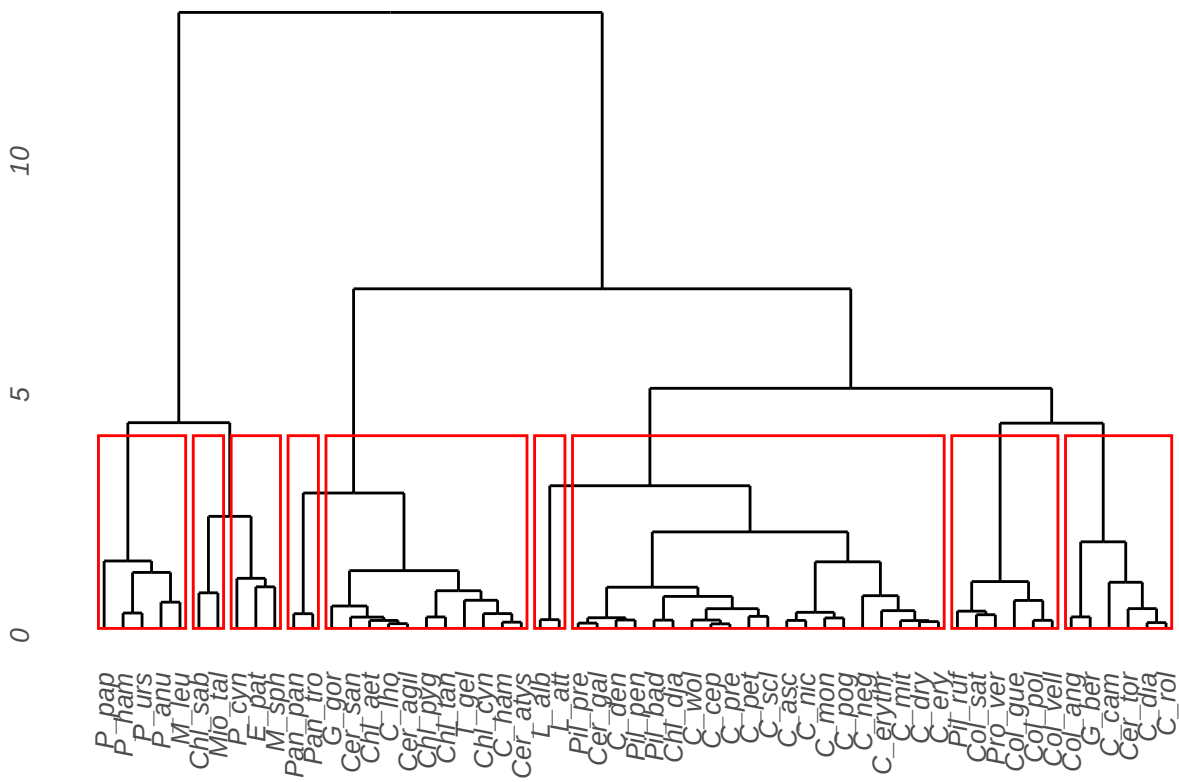
Tables showing significant associations between environmental variables and species traits from fourth corner.

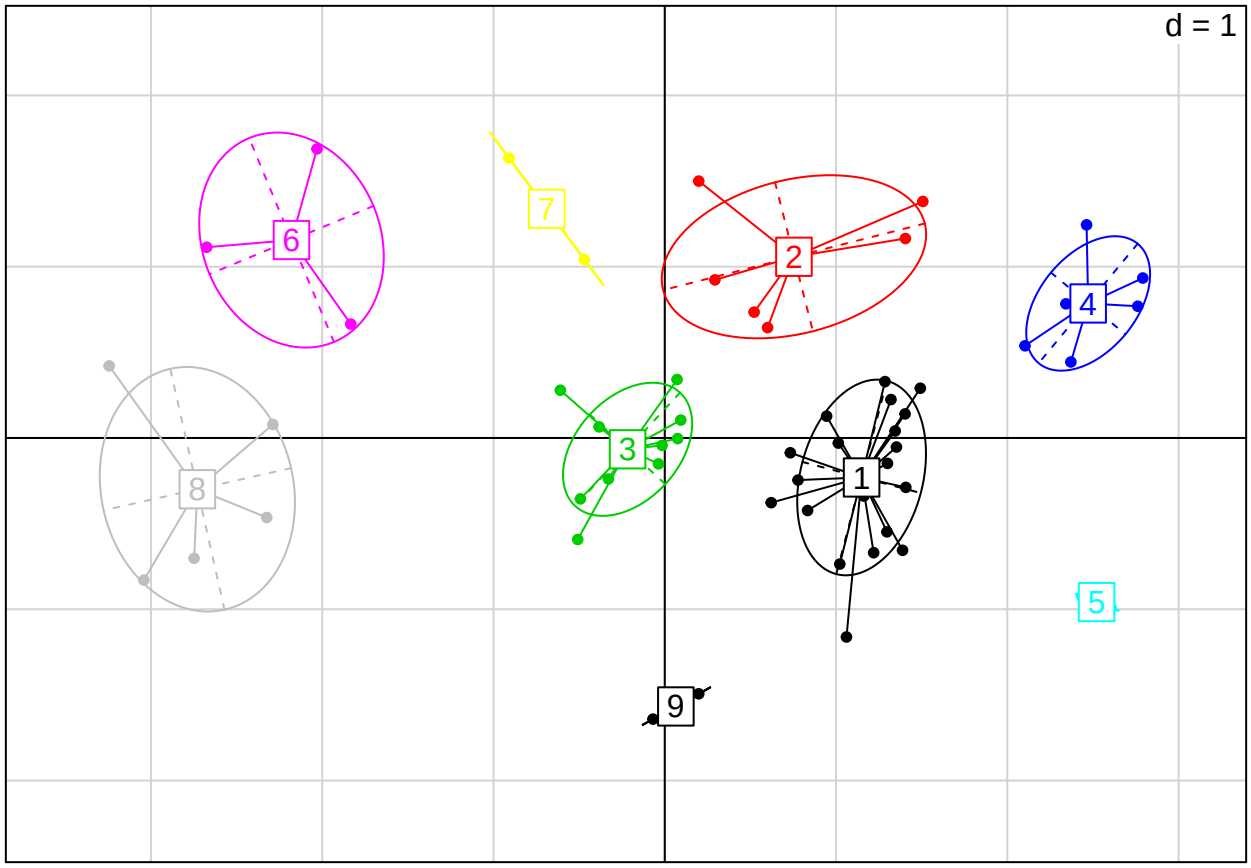




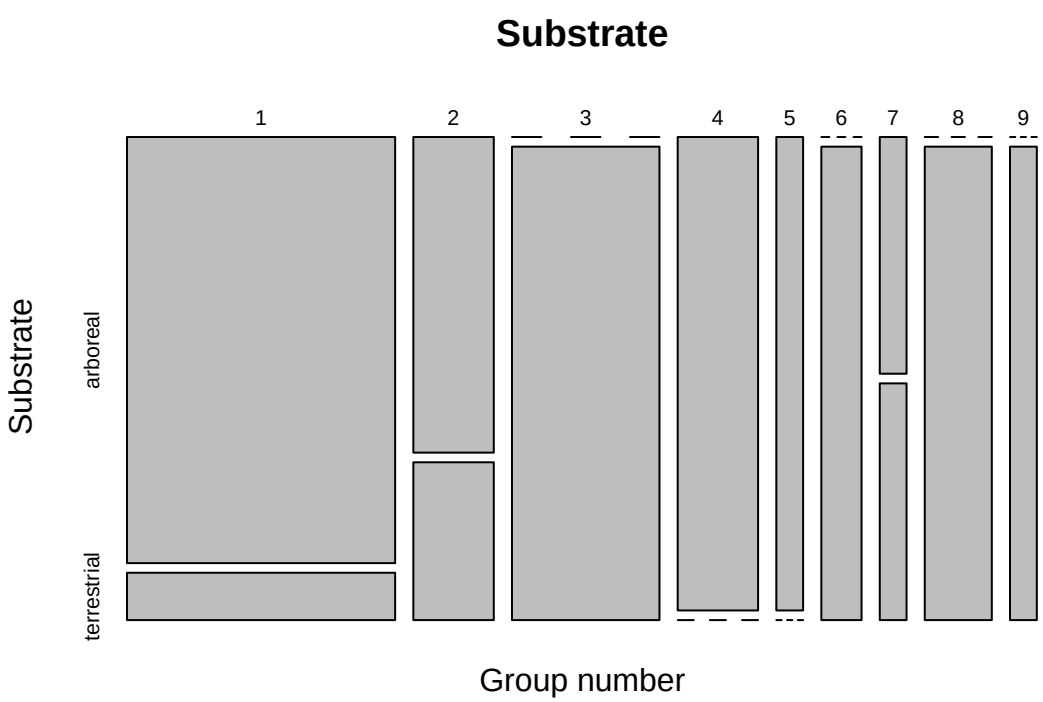
Hierarchical cluster analysis on trait scores

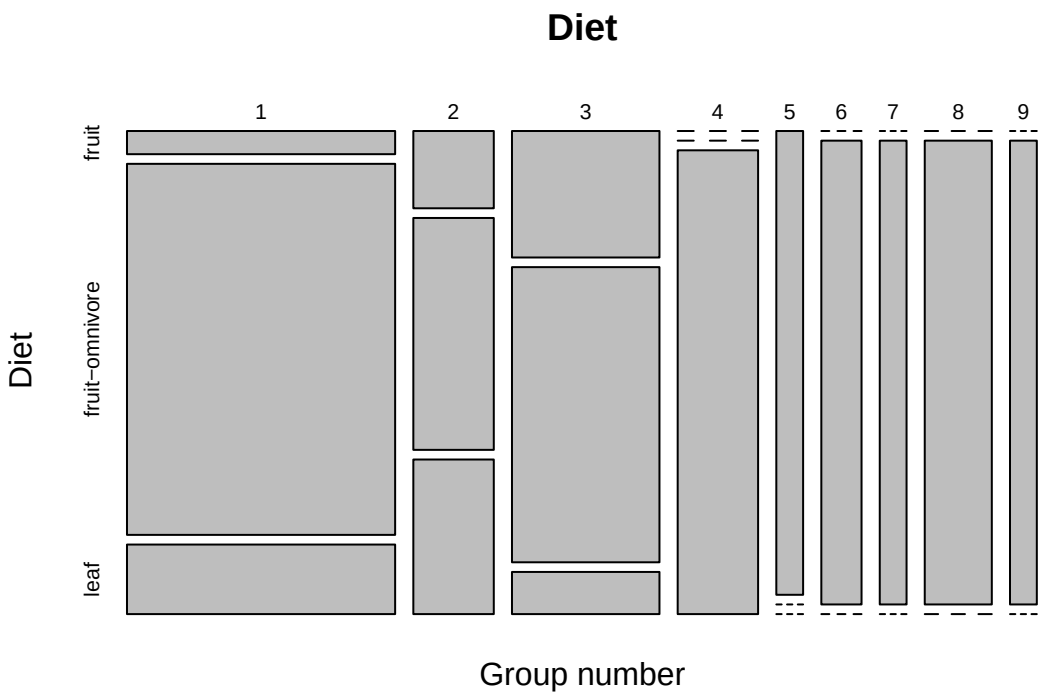
Cluster dendrogram showing species groups, and ordination plot showing group clusters in the RLQ matrix.

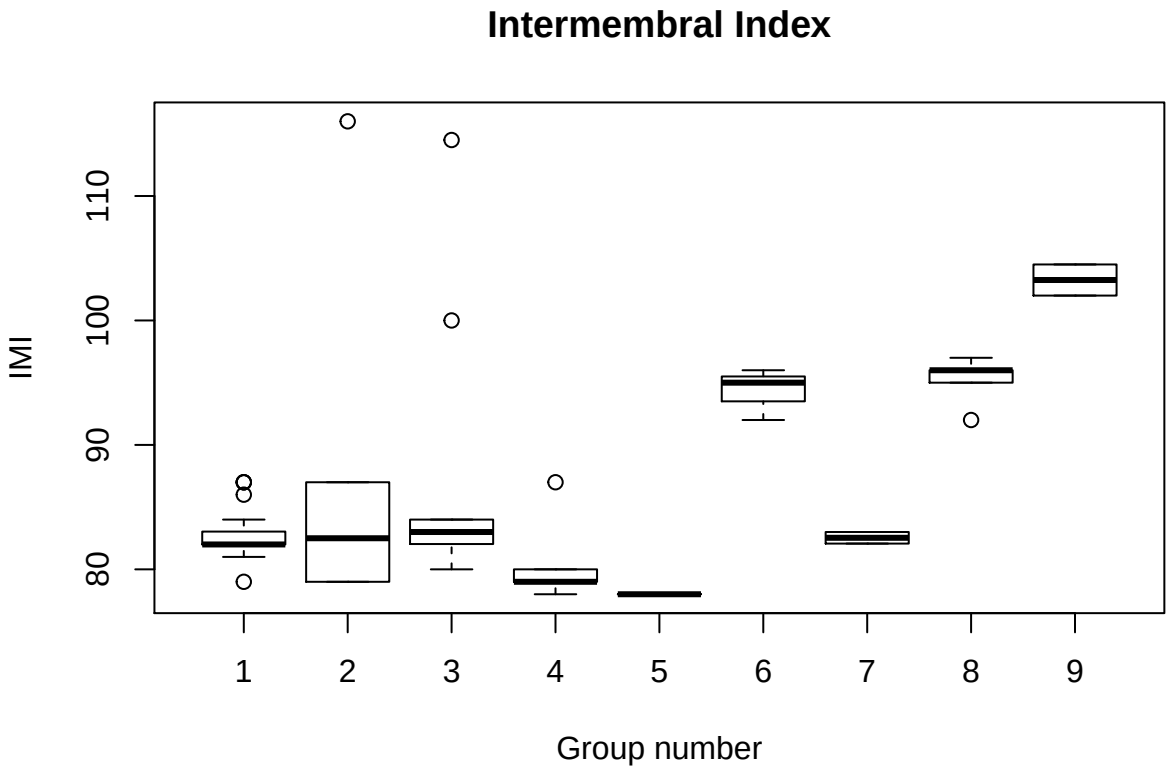

0
5
10
P_pap
P_ham
P_urs
P_anu
M_leu
Chl_sab
Mio_tal
P_cyn
E_pat
M_spn
Pan_pan
Pan_tro
G_gor
Cer_san
Cht_aet
C_lho
Cer_agil
Chl_pyg
Cht_tan
T_gel
Chl_cyn
C_ham
Cer_atys
L_alb
L_att
Pil_pre
Cer_gal
C_den
Pil_pen
Pil_bad
Cht_dia
C_wol
C_cep
C_pre
C_pet
C_scl
C_asc
C_nic
C_mon
C_pog
C_neg
c_erythr
C_C_mit
C_C_dry
C_ery
Pil_ruf
Col_sat
Pro_ver
Col_gue
Col_pol
Col_vell
Col_ang
C_ber
C_cam
Cer_tpr
C_dia
C_rol

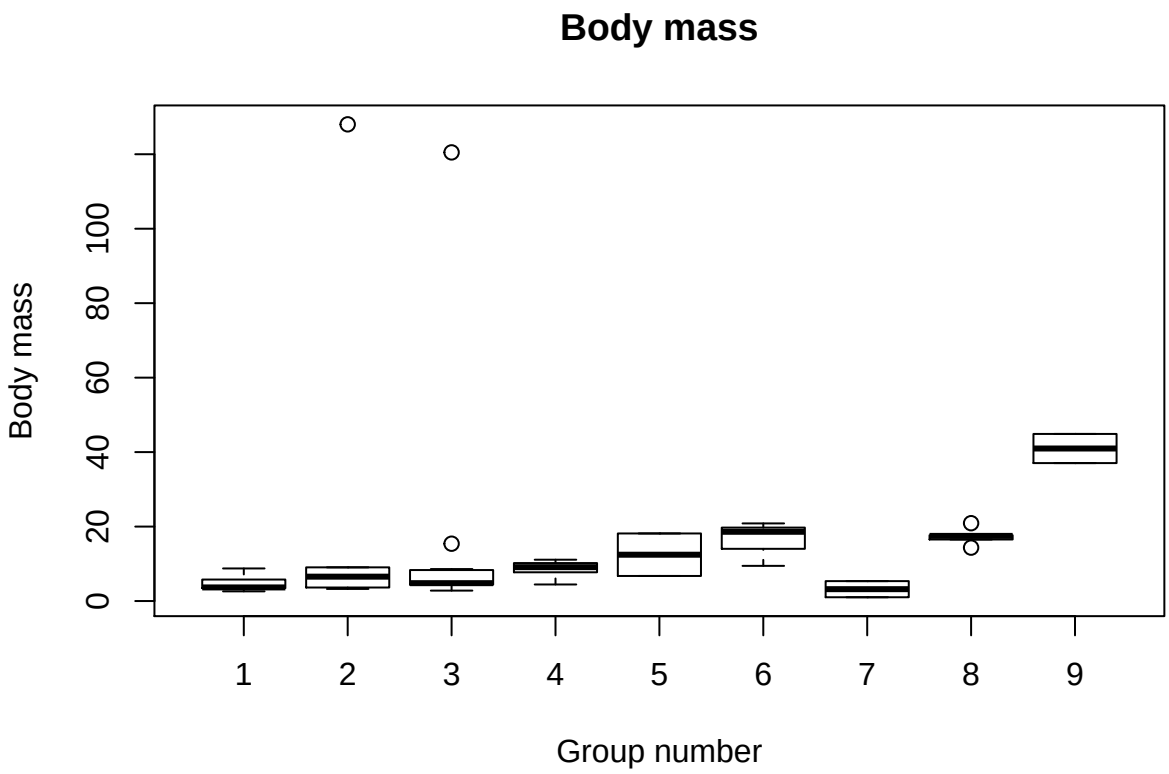


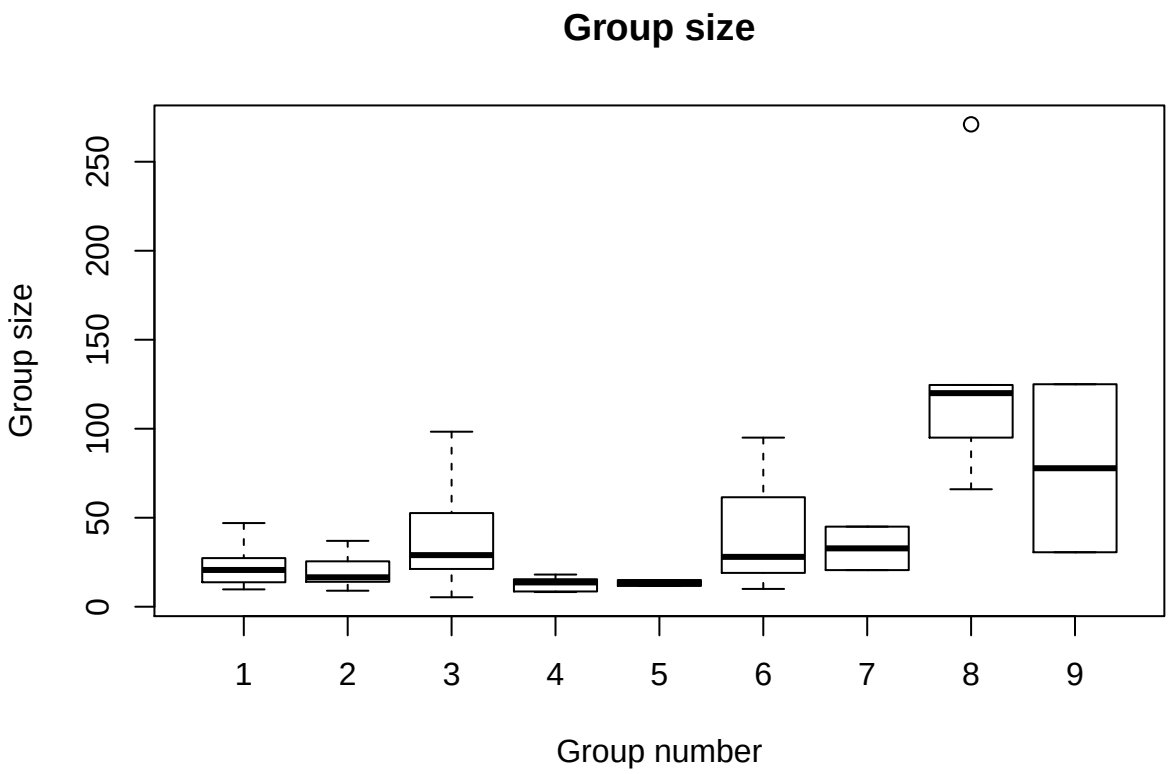
Plots of traits by functional groupss

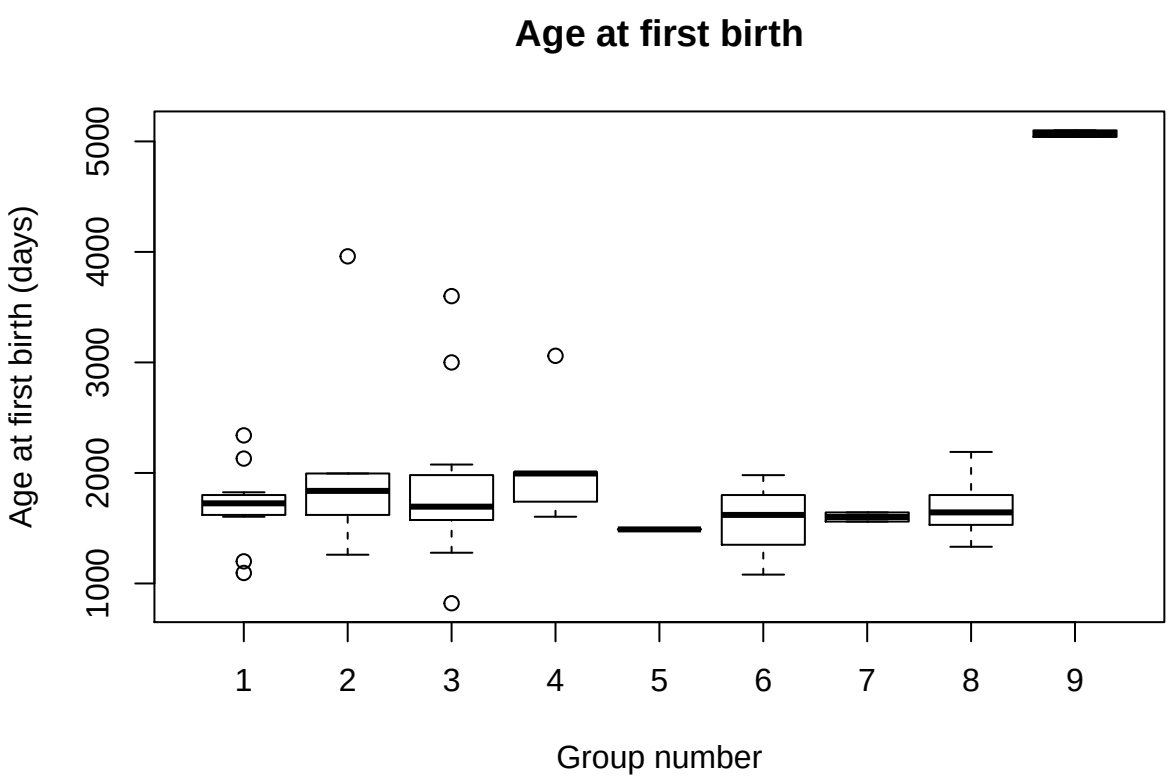

Substrate
1
2
3
4
5
6
7
8
9
Substrate
arboreal
terrestrial
Group number

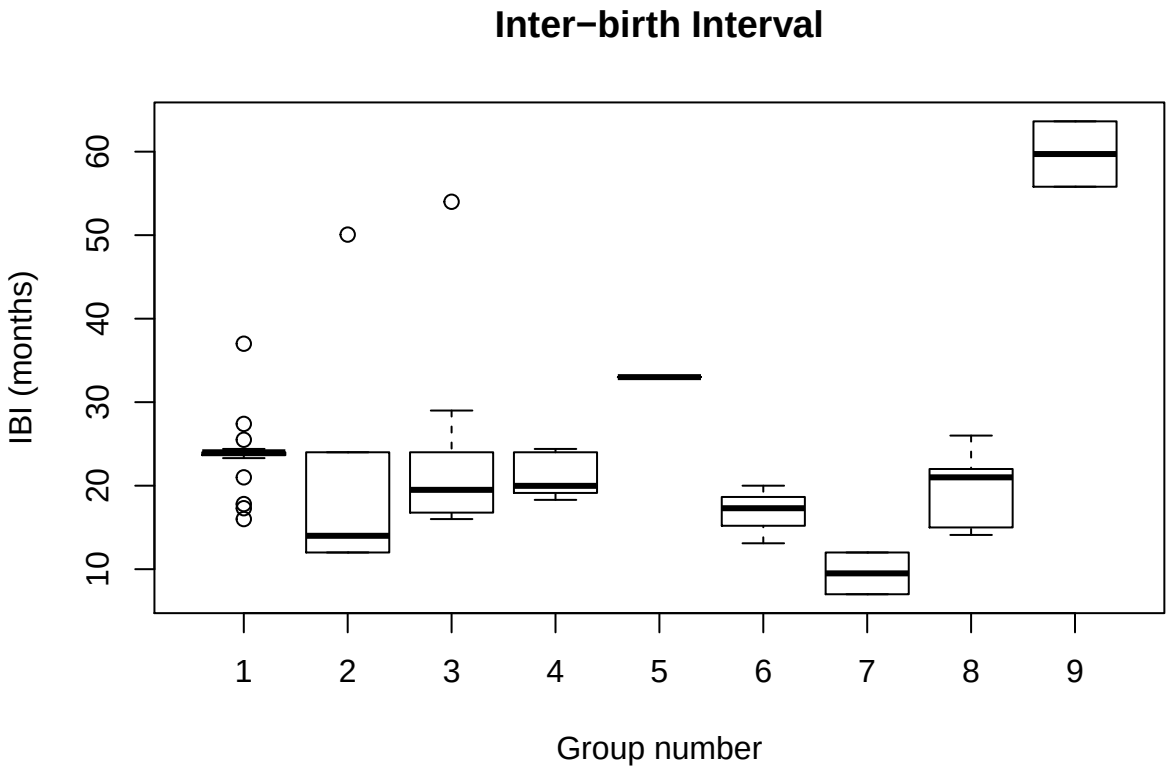

Diet
1
2
3
4
5
6
7
8
9
fruit
fruit−omnivore
leaf
Diet
Group number

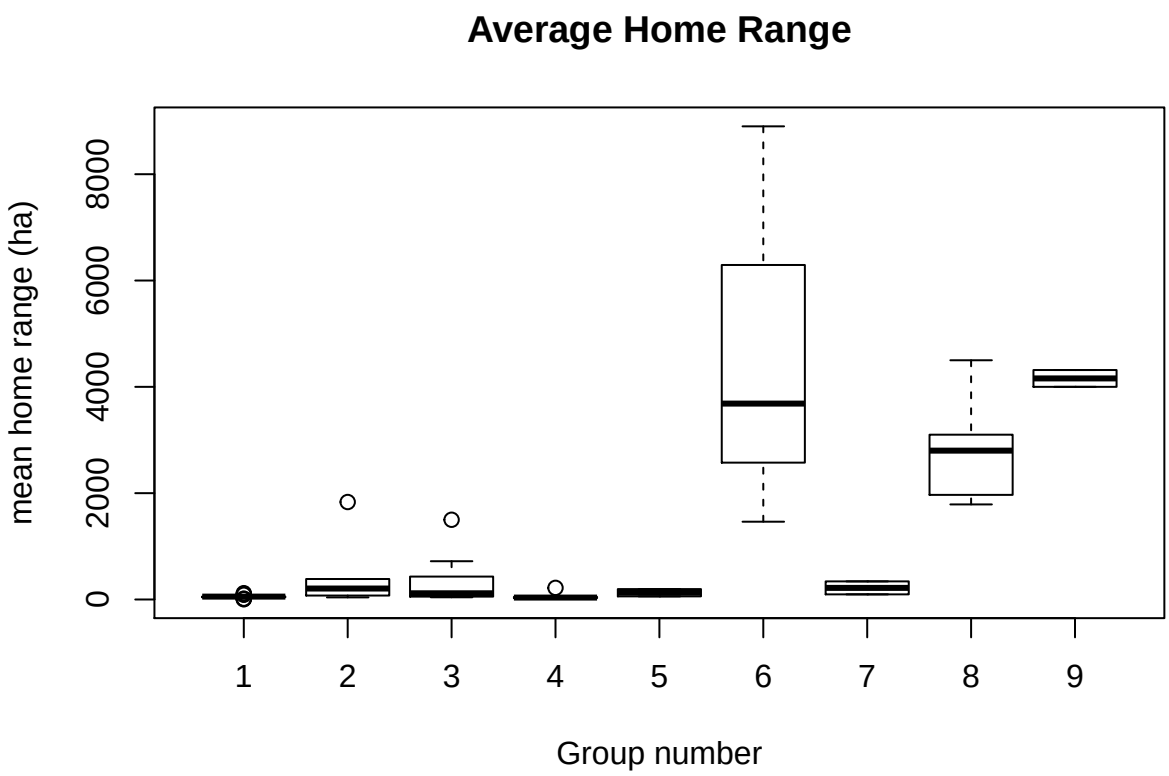

Intermembral Index
IMI
80
90
100
110
1
2
3
4
5
6
7
8
9
Group number

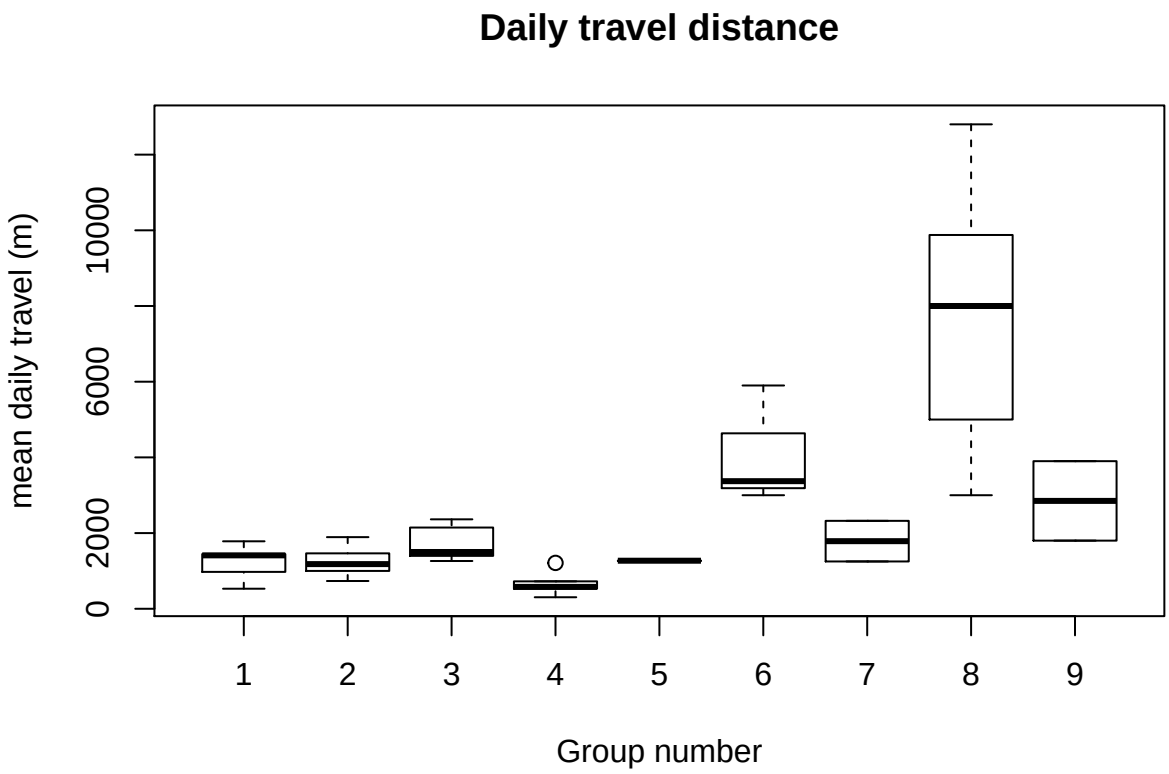

Body mass
Body mass
0
20
40
60
80
100
1
2
3
4
5
6
7
8
9
Group number


Group size
Group size
0
50
100
150
200
250
1
2
3
4
5
6
7
8
9
Group number


Age at first birth
Age at first birth (days)
1000
2000
3000
4000
5000
1
2
3
4
5
6
7
8
9
Group number


Inter−birth Interval
IBI (months)
10
20
30
40
50
60
1
2
3
4
5
6
7
8
9
Group number


Average Home Range
mean home range (ha)
0
2000
4000
6000
8000
1
2
3
4
5
6
7
8
9
Group number


Daily travel distance
mean daily travel (m)
0
2000
6000
10000
1
2
3
4
5
6
7
8
9
Group number