RDA

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1. Primer paso: cargar las librerias que necesitas.

```
library(BiodiversityR)
library(ggrepel)
library(ggplot2)
library(readxl)
library(ggsci)
library(ggforce)
library(dplyr)
```

2. Segundo paso: cargar los datos.

```
species=read.csv("data/RDA_species.csv", header=T, row.names=NULL, sep=",")
env=read.csv("data/RDA_environmetal.csv", header=T, row.names=NULL, sep=",")
```

3. Before we can use this explanatory matrix we need to check that its rows are in the same order as our response matrix all.equal(rownames(species), rownames(env))

```
all.equal(rownames(species), rownames(env))
```

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

4. Remover la columna de sitos.

```
species_1 <- select(species, -site)
env_1 <- select(env, -site)
```

5. Transformar datos. Hellinger es una transformacion recomendada por Legendre & Callagher (2001) en datos de abundancia y con una respuesta lineal

```
species_2 <- decostand(species_1, method = "hellinger")
```

6.

vegan requires that we write out each term if we are not going to

convert the factor to a dummy matrix

```
rda_tree_all = vegan::rda(species_2 ~ temperature + pH +
                oxygen + conductivity + plants, data= env_1, scale=T)
rda_tree_all
```

```
## Call: rda(formula = species_2 ~ temperature + pH + oxygen +
## conductivity + plants, data = env_1, scale = T)
##
##               Inertia Proportion Rank
## Total         47.0000     1.0000
## Constrained    8.9073     0.1895    5
## Unconstrained 38.0927     0.8105   47
## Inertia is correlations
##
## Eigenvalues for constrained axes:
##  RDA1  RDA2  RDA3  RDA4  RDA5
## 4.067 2.255 1.376 0.792 0.417
##
## Eigenvalues for unconstrained axes:
##   PC1   PC2   PC3   PC4   PC5   PC6   PC7   PC8
## 5.045 4.820 3.785 2.839 2.079 1.798 1.619 1.404
## (Showing 8 of 47 unconstrained eigenvalues)
```

7. Summary http://dmcglinn.github.io/quant_methods/lessons/multivariate_models.html

Inertia is another name for variation or variance in this case. "Total" refers to total variance "Constrained" refers to the amount of variance explained by the explanatory variables, "Unconstrained" refers to the residual variance. Constrained + Unconstrained = Total.

An R2 statistic can be derived simply as Constrained / Total.

```
summary(rda_tree_all)
```

```
##
## Call:
## rda(formula = species_2 ~ temperature + pH + oxygen + conductivity +      plants, data = env_1, scale
##
## Partitioning of correlations:
##               Inertia Proportion
## Total          47.000     1.0000
## Constrained     8.907     0.1895
## Unconstrained  38.093     0.8105
##
## Eigenvalues, and their contribution to the correlations
##
## Importance of components:
```

```
##                          RDA1    RDA2    RDA3    RDA4     RDA5    PC1    PC2
## Eigenvalue            4.06679 2.25482 1.37627 0.79194 0.417482 5.0453 4.8203
## Proportion Explained  0.08653 0.04797 0.02928 0.01685 0.008883 0.1073 0.1026
## Cumulative Proportion 0.08653 0.13450 0.16378 0.18063 0.189517 0.2969 0.3994
##                           PC3     PC4     PC5     PC6     PC7     PC8     PC9
## Eigenvalue            3.78471 2.83946 2.07941 1.79779 1.61889 1.40426 1.28896
## Proportion Explained  0.08053 0.06041 0.04424 0.03825 0.03444 0.02988 0.02742
## Cumulative Proportion 0.47995 0.54036 0.58461 0.62286 0.65730 0.68718 0.71460
##                          PC10    PC11    PC12    PC13    PC14    PC15    PC16
## Eigenvalue            1.19207 1.09439 1.08068 0.97083 0.91273 0.85041 0.78867
## Proportion Explained  0.02536 0.02328 0.02299 0.02066 0.01942 0.01809 0.01678
## Cumulative Proportion 0.73997 0.76325 0.78624 0.80690 0.82632 0.84441 0.86119
##                          PC17    PC18    PC19    PC20    PC21    PC22     PC23
## Eigenvalue            0.69918 0.61775 0.58582 0.57070 0.48347 0.46437 0.410574
## Proportion Explained  0.01488 0.01314 0.01246 0.01214 0.01029 0.00988 0.008736
## Cumulative Proportion 0.87607 0.88921 0.90168 0.91382 0.92411 0.93399 0.942723
##                           PC24    PC25     PC26     PC27     PC28     PC29
## Eigenvalue            0.384870 0.33090 0.309928 0.293196 0.235722 0.204967
## Proportion Explained  0.008189 0.00704 0.006594 0.006238 0.005015 0.004361
## Cumulative Proportion 0.950911 0.95795 0.964546 0.970784 0.975800 0.980161
##                           PC30     PC31     PC32     PC33     PC34     PC35
## Eigenvalue            0.191153 0.169063 0.125743 0.076653 0.072208 0.064563
## Proportion Explained  0.004067 0.003597 0.002675 0.001631 0.001536 0.001374
## Cumulative Proportion 0.984228 0.987825 0.990500 0.992131 0.993667 0.995041
##                           PC36      PC37      PC38      PC39      PC40
## Eigenvalue            0.049611 0.0419889 0.0381111 0.0342656 0.0228705
## Proportion Explained  0.001056 0.0008934 0.0008109 0.0007291 0.0004866
## Cumulative Proportion 0.996097 0.9969900 0.9978009 0.9985300 0.9990166
##                           PC41     PC42      PC43      PC44      PC45
## Eigenvalue            0.0163275 0.012502 0.0093315 0.0055293 1.296e-03
## Proportion Explained  0.0003474 0.000266 0.0001985 0.0001176 2.758e-05
## Cumulative Proportion 0.9993640 0.999630 0.9998285 0.9999462 1.000e+00
##                           PC46      PC47
## Eigenvalue            7.940e-04 4.408e-04
## Proportion Explained  1.689e-05 9.378e-06
## Cumulative Proportion 1.000e+00 1.000e+00
##
## Accumulated constrained eigenvalues
## Importance of components:
##                          RDA1   RDA2   RDA3    RDA4    RDA5
## Eigenvalue            4.0668 2.2548 1.3763 0.79194 0.41748
## Proportion Explained  0.4566 0.2531 0.1545 0.08891 0.04687
## Cumulative Proportion 0.4566 0.7097 0.8642 0.95313 1.00000
##
## Scaling 2 for species and site scores
## * Species are scaled proportional to eigenvalues
## * Sites are unscaled: weighted dispersion equal on all dimensions
## * General scaling constant of scores:  7.194377
##
##
## Species scores
##
##                         RDA1      RDA2      RDA3      RDA4      RDA5        PC1
## acan_speculum      -0.56635  0.174225  0.012091 -0.059736  0.027177  0.0555015
```

```
## acan_trilobatum     0.22379  0.201319 -0.424041  0.085697  0.116983 -0.2831852
## ani_allopterum      0.34237 -0.225464  0.033024  0.034060 -0.054269 -0.4931210
## arg_anceps          0.53063 -0.068151 -0.074167 -0.076600 -0.191017 -0.0769561
## arg_ellongata       0.38020 -0.028739 -0.126081 -0.239406 -0.003290 -0.4432599
## arg_pulla           0.20645  0.199453 -0.416753  0.096749  0.093944 -0.2005521
## arg_translata       0.11795 -0.026002 -0.138746 -0.147740  0.038229 -0.1666081
## bra_furcata        -0.19121  0.357038  0.273934  0.022463  0.037009  0.5482178
## can_vibex           0.16613  0.017311 -0.055460  0.040377  0.072448 -0.2712934
## dyt_nigra           0.06760  0.328213  0.117171  0.232796 -0.208999  0.4861273
## dyt_sterilis        0.42742  0.014951 -0.190910 -0.066271  0.081848 -0.3244196
## ena_civile          0.28133  0.051758 -0.076657 -0.222578 -0.034812  0.4988285
## ena_novaehispaniae  0.10535  0.175792 -0.011138 -0.282879 -0.132417  0.0889268
## erythe_attala      -0.58814  0.058109 -0.085068  0.050608  0.046613  0.1945645
## erythe_peruviana   -0.40640  0.089686 -0.112724 -0.079167  0.065561 -0.0517349
## erythe_plebeja     -0.36344 -0.069846 -0.132813  0.114418  0.061040  0.2363204
## erythe_vesiculosa   0.15599 -0.150890 -0.057331 -0.134456  0.178474  0.1744324
## erythr_fervida     -0.43529  0.123737  0.016983 -0.105057  0.074120  0.3420191
## erythr_funerea      0.14350  0.145748  0.254622 -0.268198  0.099007  0.2192590
## erythr_fusca       -0.57750  0.117559  0.098058 -0.308824 -0.052209 -0.0154398
## erythr_umbrata      0.09625  0.210565 -0.051355  0.214595 -0.160077  0.0542030
## het_cruentata       0.28978 -0.110885  0.013473 -0.128867 -0.149976 -0.3434451
## isc_capreola       -0.44929 -0.474919  0.090810  0.168794 -0.024459  0.2201268
## isc_ramburii       -0.12392 -0.566227  0.261880 -0.008813  0.085193  0.0888216
## les_tenuatus        0.17328 -0.007860  0.005584  0.051217  0.117939 -0.4603314
## lib_herculea       -0.31406 -0.081507 -0.354544 -0.077658 -0.161722  0.2355933
## mac_pseudimitans    0.08469  0.141945 -0.020065 -0.045587 -0.002069 -0.4095923
## mia_marcella        0.03101  0.369162  0.327434 -0.025711  0.079036  0.6348831
## mic_aequalis       -0.25930  0.132426 -0.062756  0.004040 -0.120485  0.0009114
## mic_atra           -0.18845 -0.005004 -0.034717  0.224143 -0.014931 -0.0803580
## mic_mengeri         0.06803  0.356810  0.133127  0.169256 -0.086707  0.5379574
## mic_ocellata       -0.55827  0.046166 -0.066868 -0.157877 -0.059001  0.0391176
## mic_schumanni       0.08663  0.095410  0.070262 -0.135939 -0.086617 -0.4900225
## neo_cultellatum    -0.33112  0.258514  0.045463 -0.139860  0.078101  0.3507857
## oli_umbricola       0.00000  0.000000  0.000000  0.000000  0.000000  0.0000000
## ort_discolor        0.18884  0.271442 -0.320455  0.074843 -0.008280 -0.5106693
## ort_ferruginea      0.19892  0.335125  0.310869  0.076157  0.003996  0.6103688
## pal_lineatipes      0.16079 -0.079136 -0.023440  0.077224 -0.096927 -0.0946139
## pan_flavecens       0.18745  0.355312  0.278650  0.057720 -0.009532  0.6022441
## pan_hymenaea        0.14232  0.206311  0.190710  0.018467  0.184033  0.6116925
## per_mooma          -0.01314  0.559071 -0.103248  0.034689  0.066810  0.3170722
## rem_luteipennis     0.03717 -0.379952  0.187306  0.227218  0.120282 -0.4528407
## rhi_jalapensis      0.17012 -0.091011  0.098058  0.049158 -0.157195 -0.1159048
## tau_argo            0.00000  0.000000  0.000000  0.000000  0.000000  0.0000000
## tau_australis       0.01700  0.306013  0.029876  0.142745  0.039210  0.4338115
## tel_digiticolis    -0.57986  0.034523 -0.128704  0.109802 -0.004543  0.2215035
## tel_filiola        -0.58657  0.044191 -0.201962  0.020802 -0.076858  0.2069809
## tel_salva          -0.26606  0.160484  0.062011 -0.020506 -0.076262 -0.0282824
## Gomphidae           0.18263  0.138073 -0.302768  0.054845  0.133397 -0.1991074
##
##
## Site scores (weighted sums of species scores)
##
##           RDA1      RDA2     RDA3     RDA4      RDA5      PC1
## row1  -2.34062  0.367106 -0.86489  0.35331  1.398270  0.80689
```

```
## row2  -0.06932 -1.720847  0.96051  1.12267  0.647840  0.06049
## row3   1.20432  0.523913 -3.02251  0.22035  1.848212 -0.61954
## row4   0.76929 -0.265067 -0.63310 -0.19901  0.729802 -0.05932
## row5   0.13512 -1.136051  0.70430  0.18790  0.416868  0.08071
## row6   1.62816 -1.131078  0.22063 -0.90133 -5.543507 -0.78772
## row7  -3.06222  0.409328 -2.28831 -0.80906 -1.719443  1.05261
## row8  -0.06623 -1.669057  0.92494  1.02285  0.575982 -0.06461
## row9   0.75463  0.596024 -1.86921  0.97715  2.122455 -0.56325
## row10  0.47967 -1.177751  0.28321 -0.61564 -1.129926  1.79942
## row11  0.63178 -0.373815  0.04090 -0.81800 -0.709860  0.07991
## row12  0.67378 -1.354297 -0.09839 -1.34885 -2.442458 -0.38932
## row13 -3.04431  0.254577 -2.21428 -0.70320 -2.306937  1.20211
## row14 -0.30342 -1.584942  0.84487  0.98682 -0.002383 -0.75783
## row15  0.86311  0.835042 -2.97650  1.28609  2.804836 -0.36456
## row16  0.60442 -0.964110 -0.26359 -1.49993  3.174251  1.18549
## row17  0.46498  0.618156  0.58847  0.15026  0.162726 -0.10825
## row18  0.81394 -1.119690 -0.07207 -0.26968 -2.788060 -0.77797
## row19 -2.77075  1.005968 -0.47312  0.02145  1.091618  0.48056
## row20 -0.45553 -1.662763  0.66237  3.05968  0.096906 -0.54614
## row21  1.02234  1.867314 -2.71759  2.80580 -0.549668 -0.51699
## row22  0.34608  0.156511 -0.33556 -0.67849 -1.615253  0.35243
## row23  0.28405  0.783592  0.95821  0.39643 -0.804511  0.42092
## row24  1.33565 -1.061082 -0.64079 -0.12060 -5.316509 -0.64302
## row25 -0.55971 -0.006254  0.46939 -1.96208 -0.964995 -1.07580
## row26  0.01830 -1.513783  0.71931  0.77932  0.265327 -0.23655
## row27  0.40808  1.282277 -1.64128  0.03989  1.334484 -0.83463
## row28  0.37897  0.354380 -0.32374  0.21877  0.432733 -0.26413
## row29  0.92409  4.680181  4.16703  4.48033 -0.351811  2.94831
## row30  1.05812 -0.896667 -0.02988 -1.09425 -1.022010 -2.52276
## row31 -1.42812  0.689193 -0.12277 -0.24389  0.384007  0.01594
## row32 -0.14991 -1.693987  0.89385  0.95120  0.191491 -0.05879
## row33  0.80533  1.022034 -2.71260  1.11141  2.690842 -0.53659
## row34  0.19001  0.251339 -0.12070 -1.20899 -1.876603  0.46121
## row35  0.49174  2.861819  3.02607  3.59647 -4.164108  1.76896
## row36  1.23195 -0.689798 -0.22319  0.35051  0.128912 -2.14819
## row37 -2.71587  1.057302 -1.15422 -0.61626  0.231418  0.03008
## row38 -0.32729 -1.485983  0.86009  0.30837  0.307584 -0.44787
## row39  0.28076  0.476911 -0.20191 -1.08242 -0.802799 -0.07814
## row40  0.34499  1.715944  2.39958  0.65230 -0.340980  1.16210
## row41  0.97919 -0.925196 -0.20365  1.16152  0.081045 -1.26536
## row42 -2.17756  1.338554  0.09762 -1.24805  0.764429  0.05379
## row43 -0.27012 -1.712056  0.97535  0.77526  0.443011 -0.05352
## row44  1.09828  0.954697 -3.77708 -1.13249  2.684427 -0.77128
## row45  0.20924 -0.210026  1.34341 -3.22416  0.631511  0.04522
## row46  0.28275  1.441965  3.19228 -0.19459  2.430683  1.56899
## row47  0.92245 -0.901607 -0.55128 -0.77293  0.874007 -0.65333
## row48 -1.42792  0.908313 -0.48685  0.44698  0.384335  0.34872
## row49 -0.02002 -1.832898  0.92859  1.30624  0.352968 -0.05425
## row50  1.01503  0.898435 -3.23009 -0.82234  1.957650 -0.88713
## row51  0.33127  0.030597  0.31750 -1.72708  0.455291 -0.13242
## row52  0.40198  1.552848  3.46976 -1.21232  2.894735  2.36774
## row53  0.83082 -1.684325  0.53337  1.46966  0.794600 -0.37659
## row54 -3.40935  1.879938 -0.22944 -1.65410 -0.799397 -0.19222
## row55 -0.05115 -1.600289  0.89217  0.65607  0.238956 -0.37738
```

```
## row56 -0.44988  0.447030  0.01173 -3.19969 -1.110610  0.26519
## row57 -0.24346  0.780408  2.63104 -1.52506  2.015678  0.81961
## row58  1.12807 -1.668277  0.36204 -0.01055 -1.678064 -0.21195
##
##
## Site constraints (linear combinations of constraining variables)
##
##           RDA1     RDA2     RDA3    RDA4     RDA5      PC1
## row1  -0.65000 -0.75055  0.15653  0.6292  1.33209  0.80689
## row2  -0.54753 -2.76358  2.09802 -1.0563 -1.57350  0.06049
## row3   0.66503  0.14970 -1.56316  0.4513  0.42498 -0.61954
## row4   1.22005 -0.76667  0.49217  0.3315 -0.81750 -0.05932
## row5   1.01834 -0.77070  1.48895 -0.9261 -0.31878  0.08071
## row6   1.15621 -0.61854  0.66643  0.3341 -1.06834 -0.78772
## row7  -1.69726 -0.20349 -2.15655 -0.2491 -1.51435  1.05261
## row8  -1.37717 -0.87285 -0.89998 -0.3247  1.16402 -0.06461
## row9   0.15802  1.03950 -1.61860  0.1697  0.15007 -0.56325
## row10  0.63955 -1.79198 -3.45850 -1.2176 -1.78612  1.79942
## row11  0.64080  0.39286  1.03709 -0.1746 -0.22942  0.07991
## row12  0.30816 -0.49323 -0.62302 -2.1018 -0.66262 -0.38932
## row13 -1.39786 -0.52769 -1.41072 -0.4644 -0.27426  1.20211
## row14 -1.36713  0.47936  0.24234  2.1373 -1.07550 -0.75783
## row15  0.72744  0.21193 -1.25614  0.7576  0.04036 -0.36456
## row16  1.06015 -1.02549 -0.38964 -0.9138  1.21296  1.18549
## row17  0.14044  1.78294  0.47397  0.6649 -0.47310 -0.10825
## row18  0.18867  0.68257 -0.16099 -0.5445 -1.45764 -0.77797
## row19 -1.12879  0.39137  0.28438  1.1261  0.01184  0.48056
## row20 -1.28076 -0.03401 -0.23595  1.5233 -0.10148 -0.54614
## row21  0.46829  1.01831 -0.85022  0.9863 -0.11149 -0.51699
## row22  0.74606 -0.06915 -0.26568  0.1874 -1.01673  0.35243
## row23  0.37931  1.21070 -0.16373  0.5002  0.82385  0.42092
## row24  1.09275 -0.53783 -0.15931  0.5248 -0.65874 -0.64302
## row25 -2.08785  0.61959  0.89390 -2.1726 -0.68515 -1.07580
## row26 -1.00180 -1.40620  0.37423 -0.5590  1.42044 -0.23655
## row27  0.42139  0.93312 -0.61545  0.4353  0.22463 -0.83463
## row28  0.59675  0.73795  0.40260  0.3312 -0.06071 -0.26413
## row29  0.11551  2.07975  0.20305  0.9701  0.26648  2.94831
## row30  0.13014  0.58374  0.32038 -1.6786  0.06746 -2.52276
## row31 -0.95014 -0.33334  1.03067  0.5295 -1.03234  0.01594
## row32 -0.54577 -1.48883  0.53941  1.4651 -0.22507 -0.05879
## row33  0.50123  0.86814 -0.95071  0.4540  1.27682 -0.53659
## row34  0.41459 -0.10646 -0.86407 -0.4445 -2.13238  0.46121
## row35  0.50477  1.11596  0.87242  1.2353 -2.10859  1.76896
## row36  0.81845  0.28973  0.36544  0.7633 -1.09268 -2.14819
## row37 -1.43302  0.56577  0.29116  0.2485  0.09561  0.03008
## row38 -1.07949 -0.78158 -0.13619  0.4217  1.55971 -0.44787
## row39  0.10510  1.17547 -0.24151 -0.8351  1.14091 -0.07814
## row40  0.52242  0.48167  1.24928 -0.6944  0.12505  1.16210
## row41  0.73457  0.25494  0.70733 -0.2331  0.27141 -1.26536
## row42 -2.00027  0.83527 -0.23406 -1.5646  1.35328  0.05379
## row43 -0.40769 -1.87423  0.81736  1.0080  0.32826 -0.05352
## row44  0.71952 -0.39567 -0.55517 -0.7756  0.39529 -0.77128
## row45  0.25292  0.65604  0.59784 -1.2433  0.07913  0.04522
## row46  0.69085  0.05078  1.31213 -1.0921  0.94963  1.56899
```

```
## row47  0.78271 -0.07583 -0.75293 -0.2442  1.45722 -0.65333
## row48 -0.93692 -0.09313  0.02035  0.8663  0.92379  0.34872
## row49 -0.65649 -1.42747 -0.07534  1.0186  1.15738 -0.05425
## row50  0.34891  0.30446 -0.87894 -0.6393 -0.14767 -0.88713
## row51  0.62508  0.15070  0.28948 -0.6872  0.52651 -0.13242
## row52  0.97592 -0.10272  1.00056 -0.1681  1.09398  2.36774
## row53  1.43720 -0.71917 -0.32373  1.0824  0.90989 -0.37659
## row54 -1.80820  1.09070  0.42144 -0.1394 -0.51830 -0.19222
## row55 -0.97992 -0.83162  0.60896  1.0147 -0.54566 -0.37738
## row56  0.07891  0.88485  0.30888 -1.4075  0.22265  0.26519
## row57  0.22334  1.05859  1.19542 -0.6582 -0.35368  0.81961
## row58  1.72452 -1.23446  0.07813  1.0416  1.03610 -0.21195
##
##
## Biplot scores for constraining variables
##
##                   RDA1    RDA2    RDA3    RDA4     RDA5 PC1
## temperature  -0.43020  0.8404 -0.3197 -0.0630 -0.05065   0
## pH            0.09972  0.1058  0.3653  0.3928 -0.83137   0
## oxygen        0.22572  0.3153  0.3833 -0.7680 -0.33595   0
## conductivity  0.39715 -0.1615 -0.8061 -0.2094 -0.35005   0
## plants       -0.87704 -0.3946  0.1208  0.2338  0.07652   0
```

```
head (summary (rda_tree_all))
```

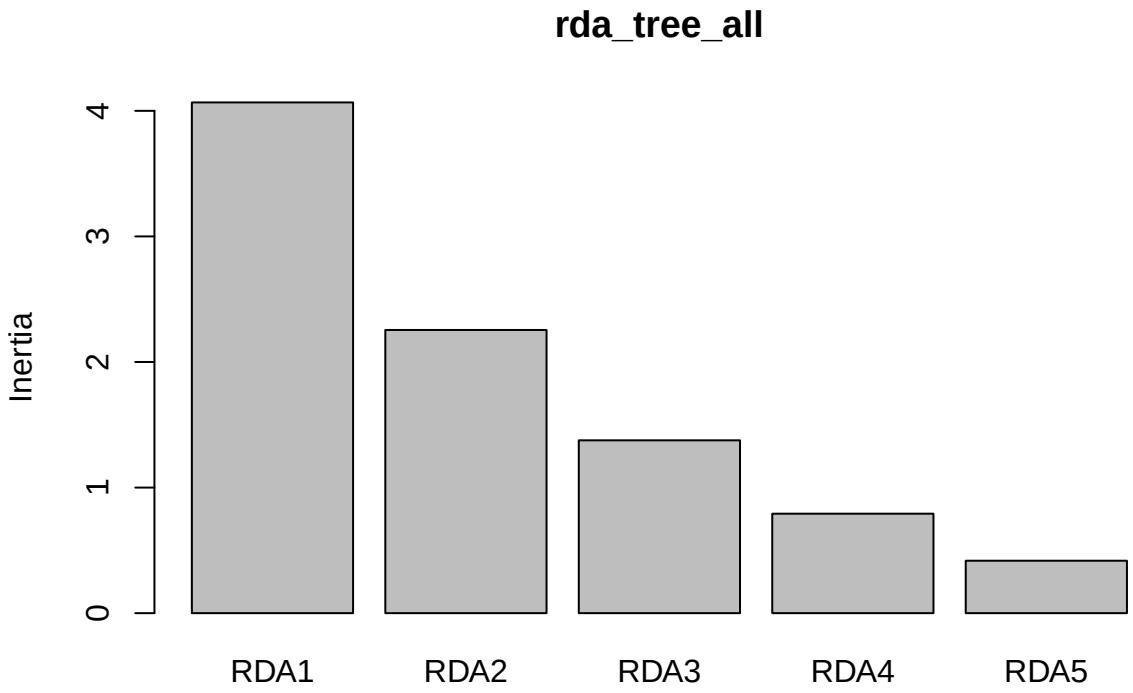
```
##
## Call:
## rda(formula = species_2 ~ temperature + pH + oxygen + conductivity +      plants, data = env_1, scal
##
## Partitioning of correlations:
##               Inertia Proportion
## Total          47.000     1.0000
## Constrained     8.907     0.1895
## Unconstrained  38.093     0.8105
##
## Eigenvalues, and their contribution to the correlations
##
## Importance of components:
##                            RDA1    RDA2    RDA3    RDA4     RDA5    PC1    PC2
## Eigenvalue            4.06679 2.25482 1.37627 0.79194 0.417482 5.0453 4.8203
## Proportion Explained  0.08653 0.04797 0.02928 0.01685 0.008883 0.1073 0.1026
## Cumulative Proportion 0.08653 0.13450 0.16378 0.18063 0.189517 0.2969 0.3994
##                            PC3     PC4     PC5     PC6     PC7     PC8     PC9
## Eigenvalue            3.78471 2.83946 2.07941 1.79779 1.61889 1.40426 1.28896
## Proportion Explained  0.08053 0.06041 0.04424 0.03825 0.03444 0.02988 0.02742
## Cumulative Proportion 0.47995 0.54036 0.58461 0.62286 0.65730 0.68718 0.71460
##                           PC10    PC11    PC12    PC13    PC14    PC15    PC16
## Eigenvalue            1.19207 1.09439 1.08068 0.97083 0.91273 0.85041 0.78867
## Proportion Explained  0.02536 0.02328 0.02299 0.02066 0.01942 0.01809 0.01678
## Cumulative Proportion 0.73997 0.76325 0.78624 0.80690 0.82632 0.84441 0.86119
##                           PC17    PC18    PC19    PC20    PC21    PC22     PC23
## Eigenvalue            0.69918 0.61775 0.58582 0.57070 0.48347 0.46437 0.410574
## Proportion Explained  0.01488 0.01314 0.01246 0.01214 0.01029 0.00988 0.008736
## Cumulative Proportion 0.87607 0.88921 0.90168 0.91382 0.92411 0.93399 0.942723
```

```
##                           PC24    PC25     PC26     PC27     PC28     PC29
## Eigenvalue            0.384870 0.33090 0.309928 0.293196 0.235722 0.204967
## Proportion Explained  0.008189 0.00704 0.006594 0.006238 0.005015 0.004361
## Cumulative Proportion 0.950911 0.95795 0.964546 0.970784 0.975800 0.980161
##                           PC30     PC31     PC32     PC33     PC34     PC35
## Eigenvalue            0.191153 0.169063 0.125743 0.076653 0.072208 0.064563
## Proportion Explained  0.004067 0.003597 0.002675 0.001631 0.001536 0.001374
## Cumulative Proportion 0.984228 0.987825 0.990500 0.992131 0.993667 0.995041
##                           PC36      PC37      PC38      PC39      PC40
## Eigenvalue            0.049611 0.0419889 0.0381111 0.0342656 0.0228705
## Proportion Explained  0.001056 0.0008934 0.0008109 0.0007291 0.0004866
## Cumulative Proportion 0.996097 0.9969900 0.9978009 0.9985300 0.9990166
##                           PC41     PC42      PC43      PC44      PC45
## Eigenvalue            0.0163275 0.012502 0.0093315 0.0055293 1.296e-03
## Proportion Explained  0.0003474 0.000266 0.0001985 0.0001176 2.758e-05
## Cumulative Proportion 0.9993640 0.999630 0.9998285 0.9999462 1.000e+00
##                           PC46      PC47
## Eigenvalue            7.940e-04 4.408e-04
## Proportion Explained  1.689e-05 9.378e-06
## Cumulative Proportion 1.000e+00 1.000e+00
##
## Accumulated constrained eigenvalues
## Importance of components:
##                          RDA1   RDA2   RDA3    RDA4    RDA5
## Eigenvalue            4.0668 2.2548 1.3763 0.79194 0.41748
## Proportion Explained  0.4566 0.2531 0.1545 0.08891 0.04687
## Cumulative Proportion 0.4566 0.7097 0.8642 0.95313 1.00000
##
## Scaling 2 for species and site scores
## * Species are scaled proportional to eigenvalues
## * Sites are unscaled: weighted dispersion equal on all dimensions
## * General scaling constant of scores:  7.194377
##
##
## Species scores
##
##                     RDA1     RDA2     RDA3     RDA4     RDA5      PC1
## acan_speculum   -0.5664  0.17423  0.01209 -0.05974  0.02718  0.05550
## acan_trilobatum  0.2238  0.20132 -0.42404  0.08570  0.11698 -0.28319
## ani_allopterum   0.3424 -0.22546  0.03302  0.03406 -0.05427 -0.49312
## arg_anceps       0.5306 -0.06815 -0.07417 -0.07660 -0.19102 -0.07696
## arg_ellongata    0.3802 -0.02874 -0.12608 -0.23941 -0.00329 -0.44326
## arg_pulla        0.2065  0.19945 -0.41675  0.09675  0.09394 -0.20055
## ....
##
##
## Site scores (weighted sums of species scores)
##
##          RDA1    RDA2    RDA3    RDA4    RDA5      PC1
## row1 -2.34062  0.3671 -0.8649  0.3533  1.3983  0.80689
## row2 -0.06932 -1.7208  0.9605  1.1227  0.6478  0.06049
## row3  1.20432  0.5239 -3.0225  0.2203  1.8482 -0.61954
## row4  0.76929 -0.2651 -0.6331 -0.1990  0.7298 -0.05932
## row5  0.13512 -1.1361  0.7043  0.1879  0.4169  0.08071
```

```
## row6  1.62816 -1.1311  0.2206 -0.9013 -5.5435 -0.78772
## ....
##
##
## Site constraints (linear combinations of constraining variables)
##
##         RDA1    RDA2    RDA3    RDA4    RDA5      PC1
## row1 -0.6500 -0.7506  0.1565  0.6292  1.3321  0.80689
## row2 -0.5475 -2.7636  2.0980 -1.0563 -1.5735  0.06049
## row3  0.6650  0.1497 -1.5632  0.4513  0.4250 -0.61954
## row4  1.2200 -0.7667  0.4922  0.3315 -0.8175 -0.05932
## row5  1.0183 -0.7707  1.4889 -0.9261 -0.3188  0.08071
## row6  1.1562 -0.6185  0.6664  0.3341 -1.0683 -0.78772
## ....
##
##
## Biplot scores for constraining variables
##
##                   RDA1    RDA2    RDA3    RDA4     RDA5 PC1
## temperature  -0.43020  0.8404 -0.3197 -0.0630 -0.05065   0
## pH            0.09972  0.1058  0.3653  0.3928 -0.83137   0
## oxygen        0.22572  0.3153  0.3833 -0.7680 -0.33595   0
## conductivity  0.39715 -0.1615 -0.8061 -0.2094 -0.35005   0
## plants       -0.87704 -0.3946  0.1208  0.2338  0.07652   0
```

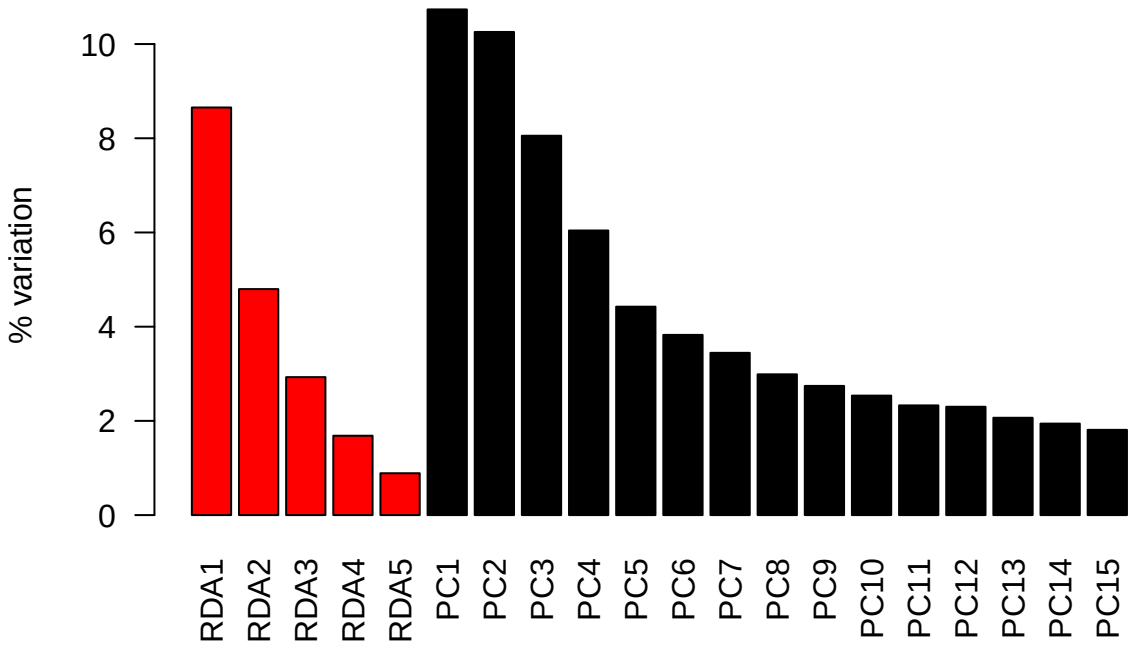
8. Plots

```
screeplot(rda_tree_all)
```



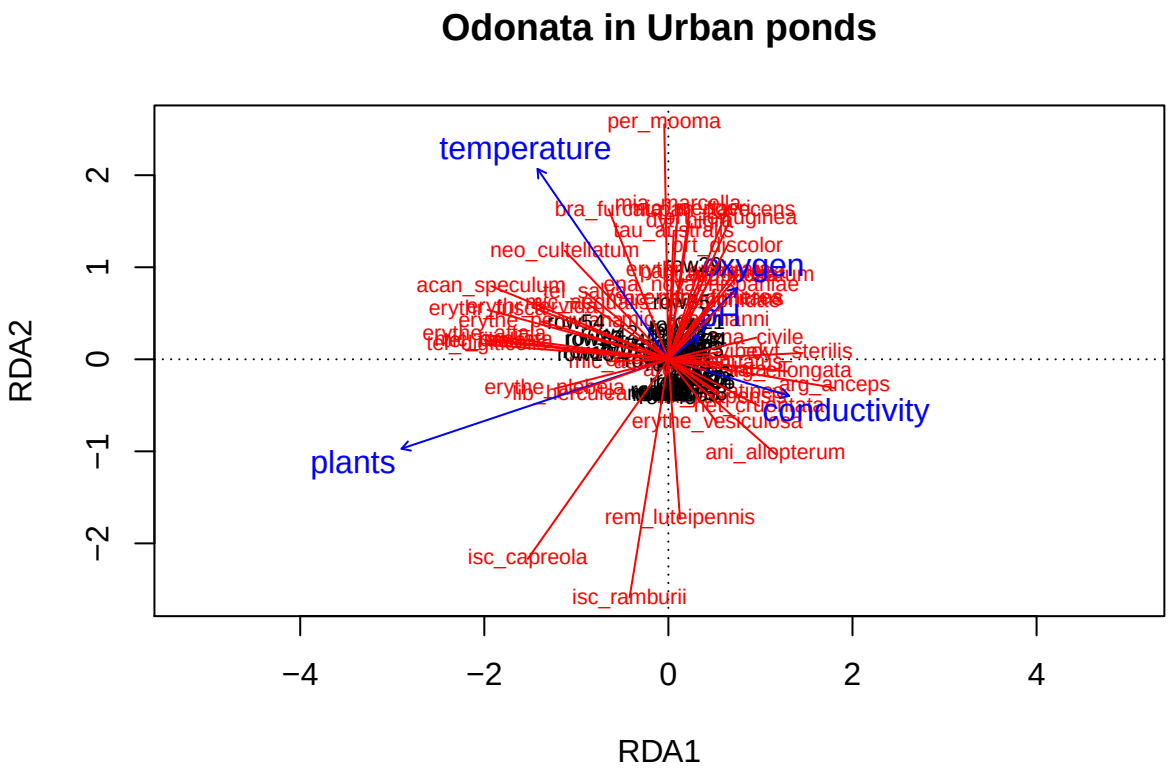
9. Percentage explained by constrained and unconstrained variables.

```
constrained_eig <- rda_tree_all$CCA$eig/rda_tree_all$tot.chi*100
unconstrained_eig <- rda_tree_all$CA$eig/rda_tree_all$tot.chi*100
expl_var <- c(constrained_eig, unconstrained_eig)
barplot (expl_var[1:20], col = c(rep ('red', length (constrained_eig)), rep ('black', length (unconstra
         las = 2, ylab = '% variation')
```



9. Ordination plots

```
plot(rda_tree_all, scaling=1, main="Odonata in Urban ponds")
spe.sc <- scores(rda_tree_all, choices=1:2, scaling=1, display="sp")
arrows(0,0,spe.sc[,1], spe.sc[,2], length=0, lty=1, col='red')
```



10. Calcular las R

```
(R2 <- RsquareAdj(rda_tree_all)$r.squared)
```

```
## [1] 0.1895171
```

```
(R2adj <- RsquareAdj(rda_tree_all)$adj.r.squared)
```

```
## [1] 0.1115861
```

```
set.seed(1)
anova.cca(rda_tree_all, by='axis', step=1000)
```

```
## Permutation test for rda under reduced model
## Forward tests for axes
## Permutation: free
## Number of permutations: 999
##
## Model: rda(formula = species_2 ~ temperature + pH + oxygen + conductivity + plants, data = env_1, sca
##          Df Variance      F Pr(>F)
## RDA1      1    4.067 5.5515  0.001 ***
## RDA2      1    2.255 3.0780  0.005 **
## RDA3      1    1.376 1.8787  0.122
```

```
## RDA4      1    0.792 1.0811  0.699
## RDA5      1    0.417 0.5699  0.963
## Residual 52   38.093
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```