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Constrained ordination

Transformation-based Redundancy Analysis (tb-RDA)

Theory R functions **Examples** Exercise 

Example 1: Vltava river valley dataset

In this example, we will apply constrained ordination on [Vltava river valley dataset](#). We will ask how much variance in species composition can be explained by two variables, soil pH and soil depth. Both are important factors for plant growth, and moreover in the study area they are somewhat correlated (shallower soils have lower pH, since prevailing geological substrate is acid).

First, upload the Vltava river valley data:

```
vltava.spe <- read.delim  
( 'https://raw.githubusercontent.com/zdealveindy/anadat-r/master/data/vltava-  
spe.txt', row.names = 1 )  
vltava.env <- read.delim  
( 'https://raw.githubusercontent.com/zdealveindy/anadat-r/master/data/vltava-  
env.txt' )  
  
spe <- vltava.spe # rename variables to make them shorter  
env <- vltava.env[, c('pH', 'SOILDPT')] # select only two explanatory  
variables
```

Upload library `vegan` and calculate tb-RDA based on Hellinger pre-transformed species composition data. Note that since the original data represent estimates of percentage cover, it is better to log transform these values first before Hellinger transformation is done:

```
library (vegan)  
spe.log <- log1p (spe) # species data are in percentage scale which is  
strongly rightskewed, better to transform them  
spe.hell <- decostand (spe.log, 'hell') # we are planning to do tb-RDA,  
this is Hellinger pre-transformation  
tbRDA <- rda (spe.hell ~ pH + SOILDPT, data = env) # calculate tb-RDA with  
two explanatory variables  
tbRDA
```

```
Call: rda(formula = spe.hell ~ pH + SOILDPT, data = env)
```

	Inertia	Proportion	Rank
Total	0.70476	1.00000	
Constrained	0.06250	0.08869	2
Unconstrained	0.64226	0.91131	94

Inertia is variance

```
Eigenvalues for constrained axes:
```

```
  RDA1    RDA2  
0.04023 0.02227
```

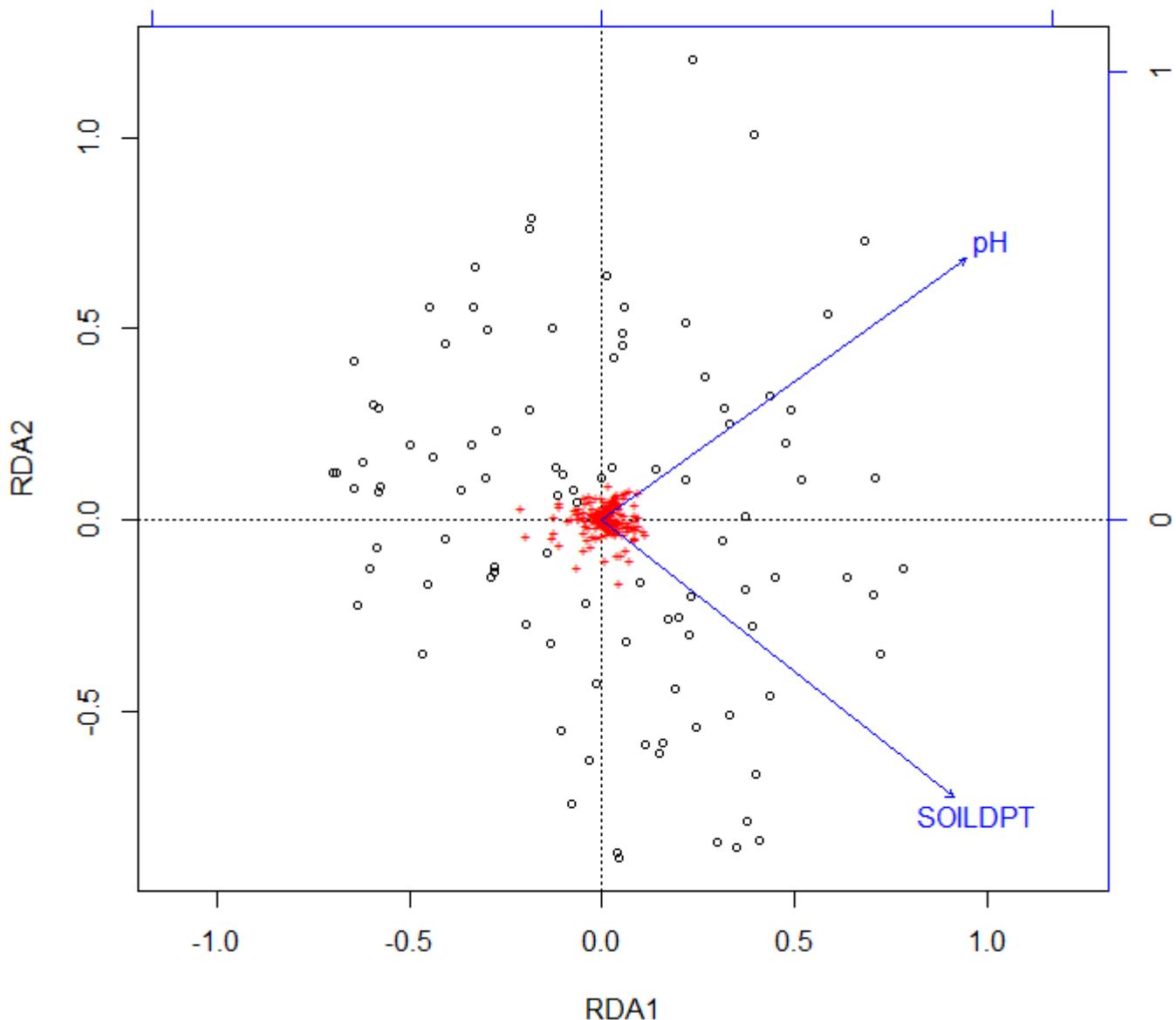
```
Eigenvalues for unconstrained axes:
```

```
  PC1    PC2    PC3    PC4    PC5    PC6    PC7    PC8  
0.07321 0.04857 0.04074 0.03144 0.02604 0.02152 0.01917 0.01715  
(Showed only 8 of all 94 unconstrained eigenvalues)
```

The two variables explain 8.9% of variance (the row Constrained and column Proportion in the table above, can be calculated also as the sum of eigenvalues for the constrained axes divided by total variance (inertia): $(0.04023+0.02227) / 0.70476 = 0.08868$. The first constrained axis (RDA1) explains $0.04023/0.70476 = 5.7\%$ of variance, while the second (RDA2) explains $0.02227/0.70476 = 3.2\%$. Note that the first unconstrained axis (PC1) represents $0.07321/0.70476 = 10.4\%$ of total variance, which is more than both explanatory variables together; the first two unconstrained explain $(0.07321+0.04857)/0.70476 = 17.3\%$. This means that the dataset may be structured by some strong environmental variable(s) different from pH and soil depth (we will check this below).

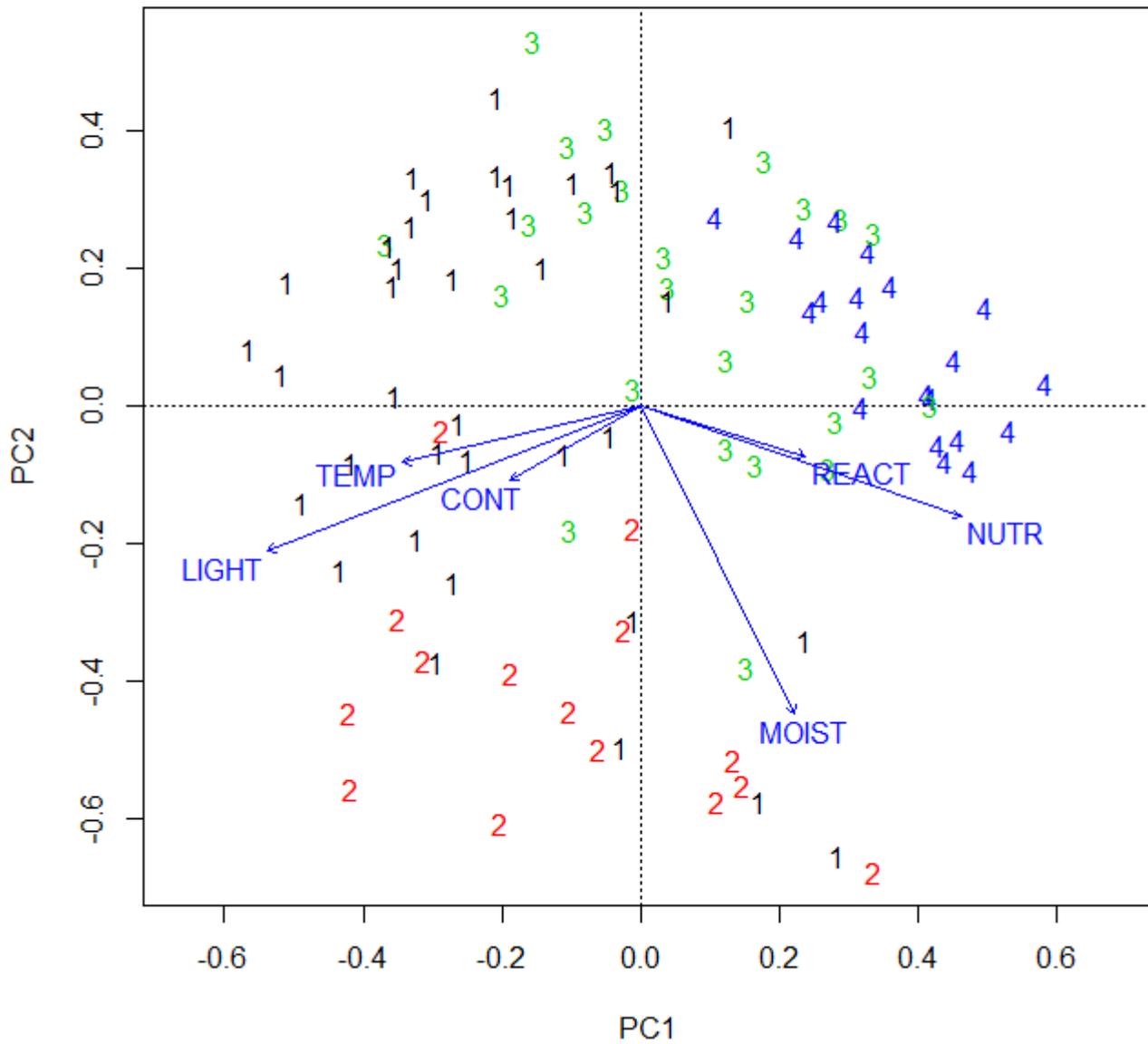
Let's see the ordination diagram:

```
ordiplot (tbRDA)
```



What may be those environmental variables associated with unconstrained axes? The `vltava.env` dataset contains a number of other measured variables which we may fit as supplementary to the first and second unconstrained axis to see which of them is most related to which of them. But here we will do an alternative thing: we will use mean Ellenberg indicator values (mEIV) calculated for each plot based on the species composition and tabulated Ellenberg species indicator values (ecological optima of species along several main environmental gradients). This approach will illustrate the situation as if in the field we measured only soil pH and depth (relatively easily obtained variables), and we use these indirect estimates to get idea about which other factors may be important.

```
ordiplot (tbrDA, choices = c(3,4), type = 'n')
points (tbrDA, choices = c(3,4), display = 'sites', pch = as.character
(vltava.env$GROUP), col = vltava.env$GROUP)
ef <- envfit (tbrDA, vltava.env[,23:28], choices = c(3,4))
plot (ef)
```



From:

<https://anadat-r.davidzeleny.net/> - **Analysis of community ecology data in R**

Permanent link:

https://anadat-r.davidzeleny.net/doku.php/en:tbrda_examples?rev=1524328696

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