

## A BRIEF INTRODUCTION TO VEGAN

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## BASIC ORDINATION

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### UNCONSTRAINED ORDINATION

What is **unconstrained**

First we look for major variation, then relate it to environmental variation  
vs. constrained ordination, where we only want to see what can be explained by  
environmental variables of interest

How well do we explain the main patterns in the species data vs how large are the  
patterns we can explain with the measured data

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### EXAMPLES OF UNCONSTRAINED ORDINATION

- Principal Components Analysis — PCA
- Correspondance Analysis — CA
- Nonmetric Multidimensional Scaling — NMDS

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BEFORE WE GET STARTED

Housekeeping

setwd("your/working/dir")

library("vegan")  
data(dune)  
data(dune.env)

Data from: Jongman, R.H.G, ter Braak, C.J.F & van Tongeren, O.F.R. (1987). Data Analysis in Community and Landscape Ecology. Pudoc, Wageningen.

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BEFORE WE GET STARTED | SPECIES

dim(dune) # number of samples, species

[1] 20 30

head(dune[,1:6])

	Achimill	Agrostol	Airaprae	Alopgeni	Anthodor	Bellpere
1	1	0	0	0	0	0
2	3	0	0	2	0	3
3	0	4	0	7	0	2
4	0	8	0	2	0	2
5	2	0	0	0	4	2
6	2	0	0	0	3	0

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BEFORE WE GET STARTED | ENVIRONMENT

head(dune.env, n=3)

	A1	Moisture	Management	Use	Manure
1	2.8	1	SF	Haypastu	4
2	3.5	1	BF	Haypastu	2
3	4.3	2	SF	Haypastu	4

summary(dune.env)

	A1	Moisture	Management	Use	Manure
Min.	: 2.800	1:7	BF:3	Hayfield:7	0:6
1st Qu.:	: 3.500	2:4	HF:5	Haypastu:8	1:3
Median :	: 4.200	4:2	NM:6	Pasture :5	2:4
Mean :	: 4.850	5:7	SF:6		3:4
3rd Qu.:	: 5.725				4:3
Max.	:11.500				

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BASIC ORDINATION

PCA finds linear combinations of the variables that explain the largest amounts of variance in the data

(pca <- rda(dune))

Call: rda(X = dune)

	Inertia	Rank
Total	84.12	
Unconstrained	84.12	19

Inertia is variance

Eigenvalues for unconstrained axes:

PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
24.795	18.147	7.629	7.153	5.695	4.333	3.199	2.782

(Shown only 8 of all 19 unconstrained eigenvalues)

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## BASIC ORDINATION

Vegan has a wrapper function for doing NMDS ordinations using best practices:

- `metaMDS()`

This will do handy things

- standardize your data if necessary
- perform rotation to PCs
- scale coordinates in half change units

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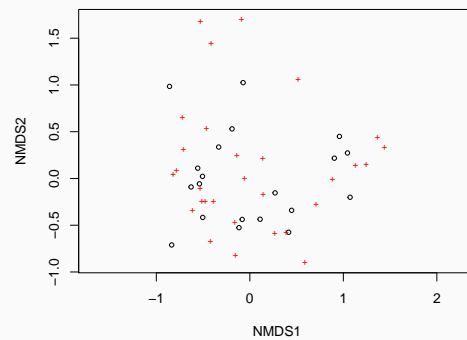
## BASIC ORDINATION AND PLOTTING

```
dune.bray.ord <- metaMDS(dune, distance = "bray", k = 2, trymax = 50)
```

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## BASIC ORDINATION AND PLOTTING (USING ALL DEFAULTS)

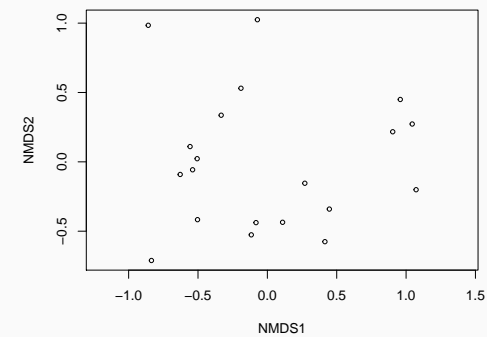
```
plot(dune.bray.ord)
```



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## BASIC ORDINATION AND PLOTTING (JUST PLOTS)

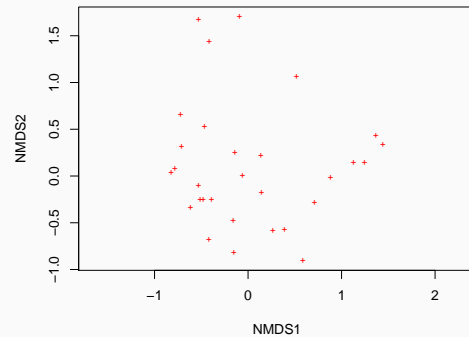
```
plot(dune.bray.ord, display = "sites")
```



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## BASIC ORDINATION AND PLOTTING (JUST SPECIES)

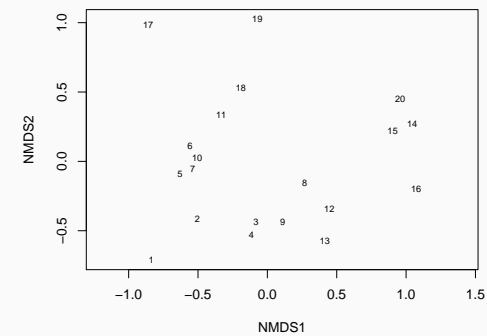
```
plot(dune.bray.ord, display = "species")
```



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## SITE NAMES INSTEAD OF POINTS

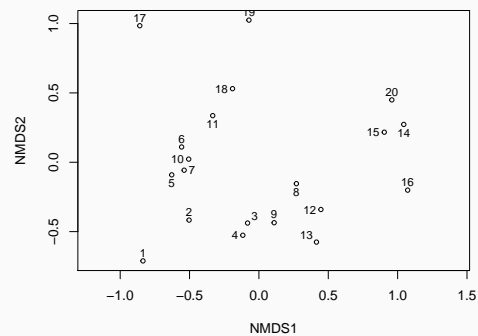
```
plot(dune.bray.ord, display = "sites", type = "text")
```



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## SITE NAMES INSTEAD OF POINTS

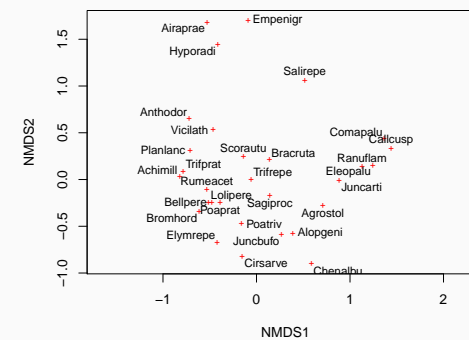
```
plot(dune.bray.ord, display = "sites")
set.seed(314) ## make reproducible
ordipointlabel(dune.bray.ord, display = "sites", scaling = 3, add = TRUE)
```



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## SITE NAMES INSTEAD OF POINTS

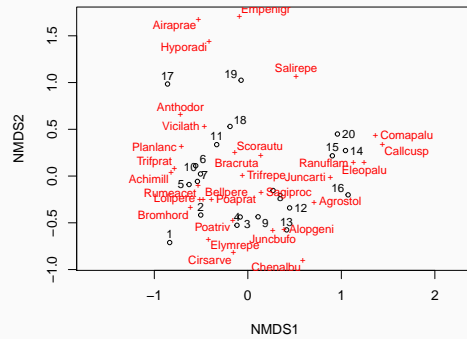
```
plot(dune.bray.ord, display = "species")
set.seed(314) ## make reproducible
ordipointlabel(dune.bray.ord, display = "species", scaling = 3, add = TRUE)
```



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## SITE NAMES INSTEAD OF POINTS

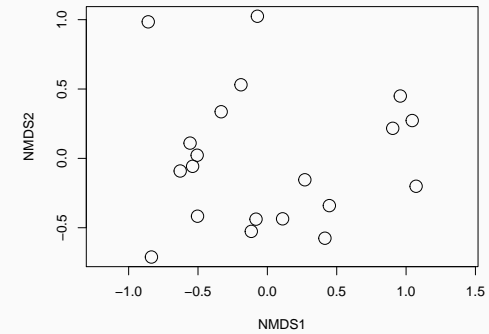
```
plot(dune.bray.ord)
set.seed(314) ## make reproducible
ordipointlabel(dune.bray.ord, scaling = 3, add = TRUE)
```



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## LARGER POINTS

```
plot(dune.bray.ord, display = "sites", cex=2)
```



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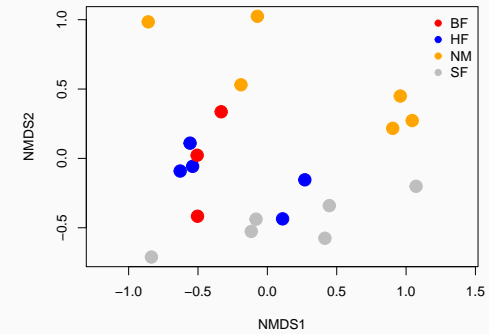
## MODIFYING THE DISPLAY OF THE POINTS WITH ENVIRONMENTAL DATA

- Color
- Shape
- Size

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## MODIFYING THE COLOR OF POINTS

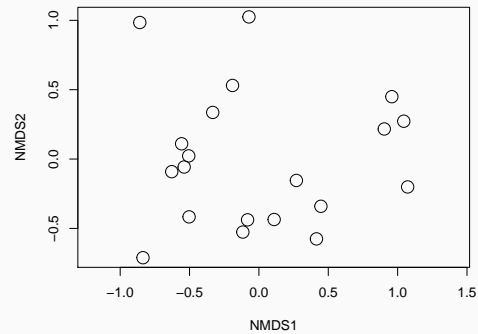
```
colors.vec <- c("red", "blue", "orange", "grey")
plot(dune.bray.ord, display = "sites", type = "n")
points(dune.bray.ord, display = "sites", cex=2, pch = 21,
       col = colors.vec[dune.env$Management],
       bg = colors.vec[dune.env$Management])
legend("topright", legend = levels(dune.env$Management), bty = "n",
       col = colors.vec, pch = 21, pt.bg = colors.vec)
```



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## ADDING OTHER LAYERS

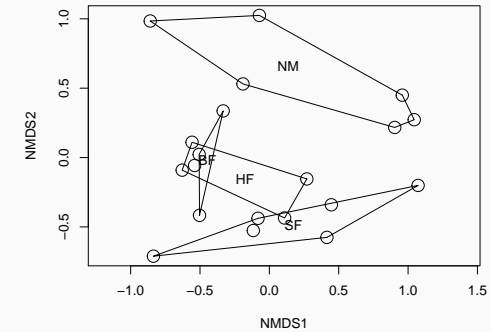
```
plot(dune.bray.ord, display = "sites", cex=2) # just site points
```



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## ADDING OTHER LAYERS

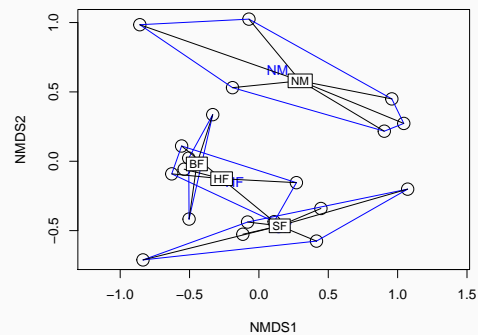
```
plot(dune.bray.ord, display = "sites", cex=2)
ordihull(dune.bray.ord, groups = dune.env$Management, label = TRUE) # convex hulls
```



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## ADDING OTHER LAYERS

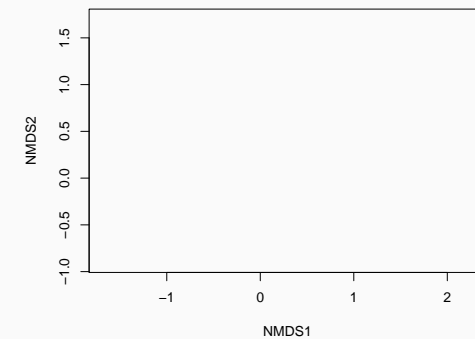
```
plot(dune.bray.ord, display = "sites", cex=2)
ordihull(dune.bray.ord, groups = dune.env$Management, label = TRUE, col = "blue")
ordispider(dune.bray.ord, groups = dune.env$Management, label = TRUE)
```



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## ADDING OTHER LAYERS - AXES SCALING

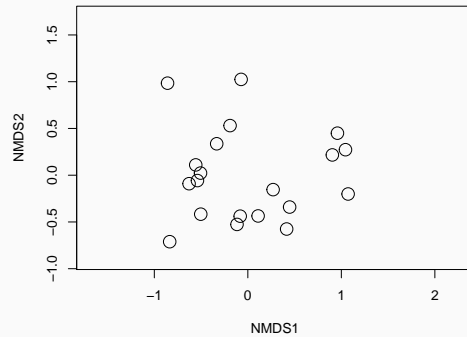
```
plot(dune.bray.ord, type = "n")
```



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## ADDING OTHER LAYERS - AXES SCALING

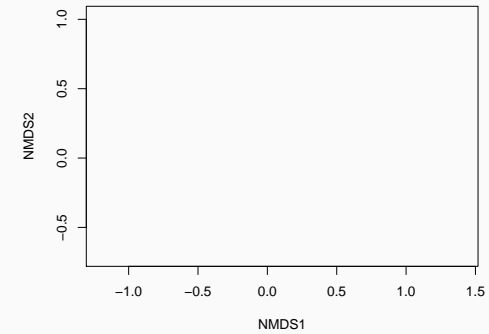
```
plot(dune.bray.ord, type = "n")
points(dune.bray.ord, display = "sites", cex = 2)
```



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## ADDING OTHER LAYERS - AXES SCALING

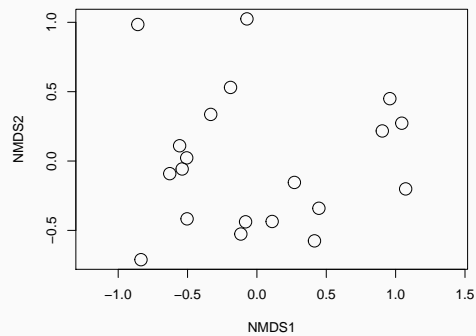
```
plot(dune.bray.ord, display = "sites", type = "n")
```



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## ADDING OTHER LAYERS - AXES SCALING

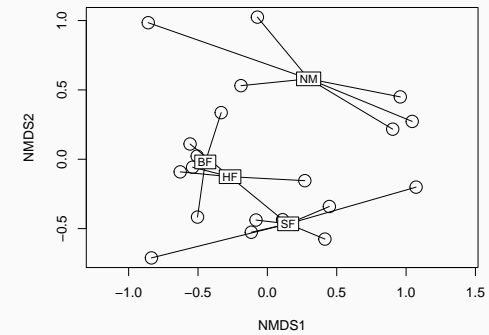
```
plot(dune.bray.ord, display = "sites", type = "n")
points(dune.bray.ord, display = "sites", cex = 2)
```



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## ADDING OTHER LAYERS

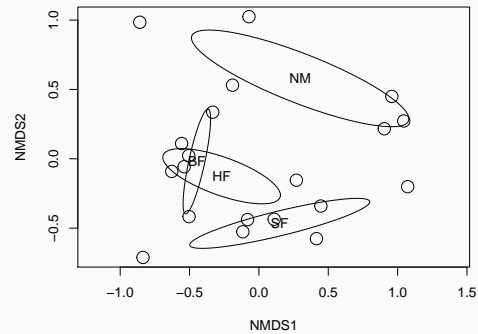
```
plot(dune.bray.ord, display = "sites", type = "n")
points(dune.bray.ord, display = "sites", cex = 2)
ordispider(dune.bray.ord, groups = dune.env$Management, label = TRUE)
```



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## ADDING OTHER LAYERS

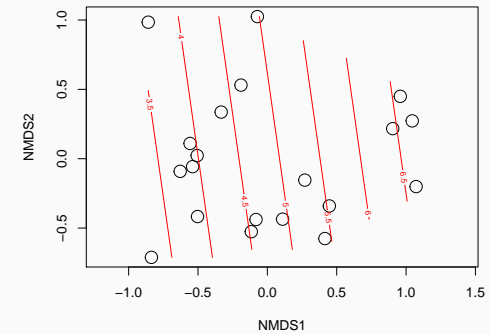
```
plot(dune.bray.ord, display = "sites", type = "n")
points(dune.bray.ord, display = "sites", cex = 2)
ordiellipse(dune.bray.ord, groups = dune.env$Management, label = TRUE)
```



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## ADDING OTHER LAYERS

```
plot(dune.bray.ord, display = "sites", type = "n")
points(dune.bray.ord, display = "sites", cex = 2)
ordisurf(dune.bray.ord, dune.env$A1, add = TRUE)
```



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## VECTORS IN ORDINATION SPACE

```
dune.bray.ord.A1.fit <- envfit(dune.bray.ord, dune.env$A1, permutations = 1000)
dune.bray.ord.A1.fit
```

\*\*\*VECTORS

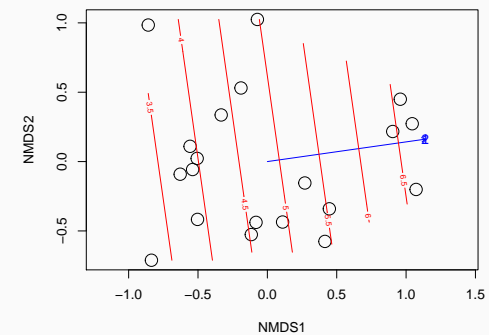
```
      NMDS1  NMDS2    r2 Pr(>r)
[1,] 0.99008 0.14052 0.3798 0.01698 *
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Permutation: free
Number of permutations: 1000
```

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## VECTORS IN ORDINATION SPACE

```
plot(dune.bray.ord, display = "sites", type = "n")
points(dune.bray.ord, display = "sites", cex = 2)
plot(dune.bray.ord.A1.fit, add = TRUE)
ordisurf(dune.bray.ord, dune.env$A1, add = TRUE)
```



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