

A (brief) introduction to ordination and the vegan package

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Datasets
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Unconstrained Ordination
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Constrained Ordination
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Permutation Tests

Datasets
oooooo

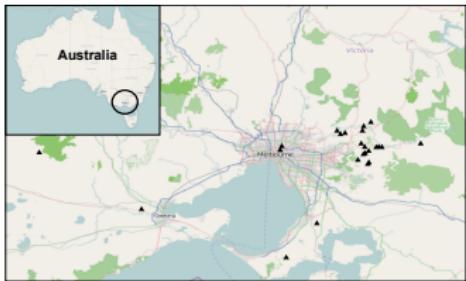
Unconstrained Ordination
oooooooo

Constrained Ordination
oo

Permutation Tests

Datasets

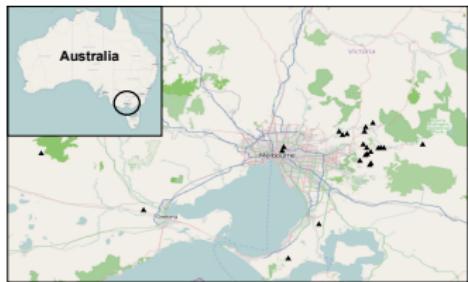
Exercise: Salinization and Pesticides



- ▶ Macroinvertebrates
- ▶ 24 sites
- ▶ covering a salinity and toxicity gradient

The dataset is published in: Szöcs, E., Kefford, B.J., Schäfer, R.B., 2012. Is there an interaction of the effects of salinity and pesticides on the community structure of macroinvertebrates? *Science of the Total Environment* 437, 121–126.

Exercise: Salinization and Pesticides



- ▶ Macroinvertebrates
- ▶ 24 sites
- ▶ covering a salinity and toxicity gradient

Questions:

- ▶ Interaction between salinization and pesticides?
- ▶ Which species are affected?
- ▶ Other influences?

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Exercise: Salinization and Pesticides

```
setwd('yourpath/3-IntroVeganPackage/data/')
abu <- read.table('melbourneAbu.csv', sep = ';', header = TRUE)
env <- read.table('melbourneEnv.csv', sep = ';', header = TRUE)
```

```
dim(env)
```

```
[1] 24 23
```

```
dim(abu)
```

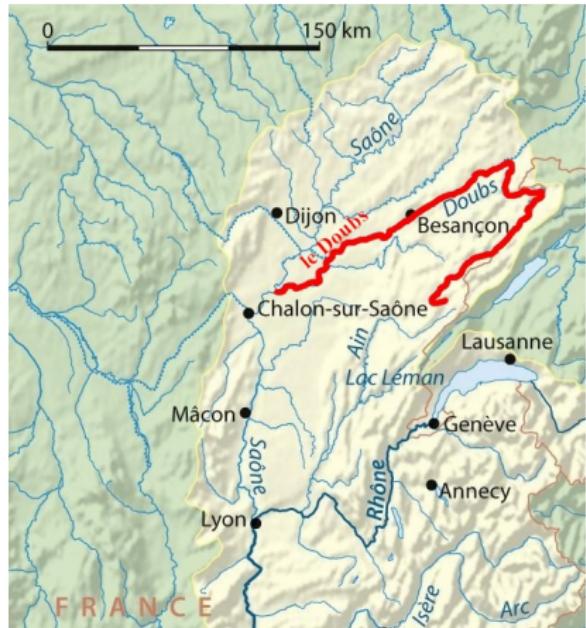
```
[1] 24 76
```

24 sites, 22 environmental variables, 75 taxa

```
head(env[ , 1:10])
```

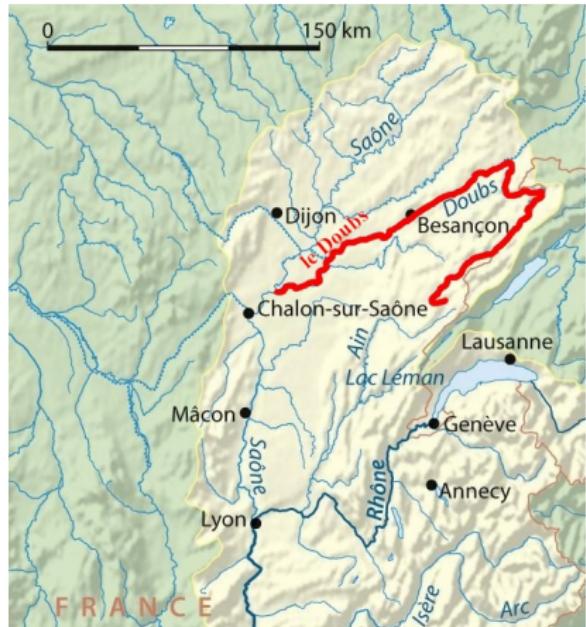
	ID	T	pH	oxygen	Depth	maxwidth	minwidth	rifperc	poolperc	Bedrock
1	1-11	16.8	7.67	80.1	0.9	15	12.0	0	100	0
2	2-11	16.5	7.29	83.0	0.9	30	15.0	0	100	0
3	3-11	17.3	7.20	77.9	0.4	4	2.5	0	100	0
4	4-11	15.6	7.84	72.0	0.7	8	2.5	0	100	0
5	5-11	17.2	6.97	69.9	0.9	7	4.0	0	100	0
6	6-11	15.5	7.26	80.0	0.2	3	2.0	5	95	0

Demonstration: Doubs river fish communities



- ▶ Fish
- ▶ 30 sites along the Doubs River

Demonstration: Doubs river fish communities



- ▶ Fish
- ▶ 30 sites along the Doubs River

Questions

- ▶ How does fish composition change downstream?
- ▶ Environmental drivers?

Demonstration: Doubs river fish communities — Species

```
setwd('your/workingdirectory')
Dabu <- read.table('doubsAbu.csv', sep = ',', header = TRUE)
Denv <- read.table('doubsEnv.csv', sep = ',', header = TRUE)
Dspa <- read.table('doubsSpa.csv', sep = ',', header = TRUE)
```

```
dim(Dabu)
```

```
[1] 30 27
```

30 sites, 27 taxa

```
head(Dabu[, 1:18])
```

	CHA	TRU	VAI	LOC	OMB	BLA	HOT	TOX	VAN	CHE	BAR	SPI	GOU	BRO	PER	BOU	PSO	ROT
1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	5	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	5	5	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0
4	0	4	5	5	0	0	0	0	0	1	0	0	1	2	2	0	0	0
5	0	2	3	2	0	0	0	0	5	2	0	0	2	4	4	0	0	2
6	0	3	4	5	0	0	0	0	1	2	0	0	1	1	1	0	0	0

Demonstration: Doubs river fish communities — Environment

```
dim(Denv)
```

```
[1] 30 11
```

30 sites, 11 variables

```
head(Denv)
```

	das	alt	pen	deb	pH	dur	pho	nit	amm	oxy	dbo
1	0.3	934	48.0	0.84	7.9	45	0.01	0.20	0.00	12.2	2.7
2	2.2	932	3.0	1.00	8.0	40	0.02	0.20	0.10	10.3	1.9
3	10.2	914	3.7	1.80	8.3	52	0.05	0.22	0.05	10.5	3.5
4	18.5	854	3.2	2.53	8.0	72	0.10	0.21	0.00	11.0	1.3
5	21.5	849	2.3	2.64	8.1	84	0.38	0.52	0.20	8.0	6.2
6	32.4	846	3.2	2.86	7.9	60	0.20	0.15	0.00	10.2	5.3

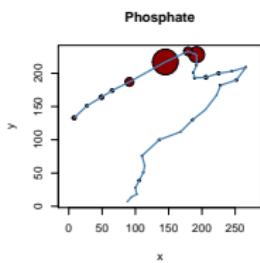
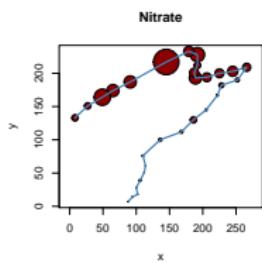
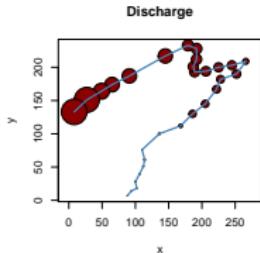
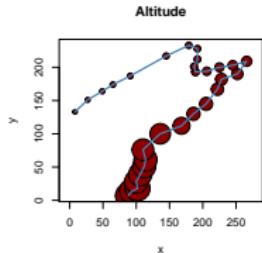
Unconstrained Ordination

Principal Components Analysis (PCA)

Principal coordinates analysis (PCoA)

Nonmetric Multidimensional Scaling (NMDS)

Principal Components Analysis (PCA) — Why?



- ▶ 11 variables

Questions:

- ▶ Which variable are correlated?
- ▶ Which sites have similar conditions?
- ▶ How do conditions change downstream?

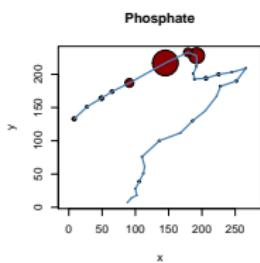
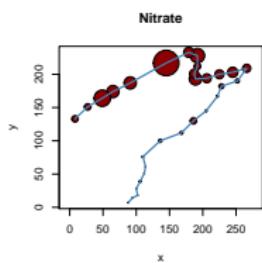
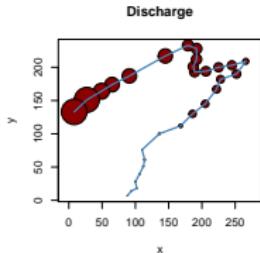
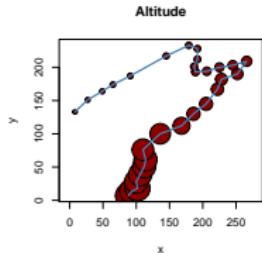
Datasets
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Unconstrained Ordination
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Constrained Ordination
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Permutation Tests

Principal Components Analysis (PCA) — Why?



- ▶ 11 variables

Questions:

- ▶ Which variable are correlated?
- ▶ Which sites have similar conditions?
- ▶ How do conditions change downstream?
- ▶ pairwise comparisons
- ▶ 3D possible
- ▶ more than 3 dimensions?

Principal Components Analysis (PCA) — What?

- ▶ *Look from another angle on the data*
- ▶ PCA is just a rotation of the coordinate system
- ▶ The rotation is done so that the first axis contains as much variation as possible
- ▶ Second axis than most of remaining variation

Datasets
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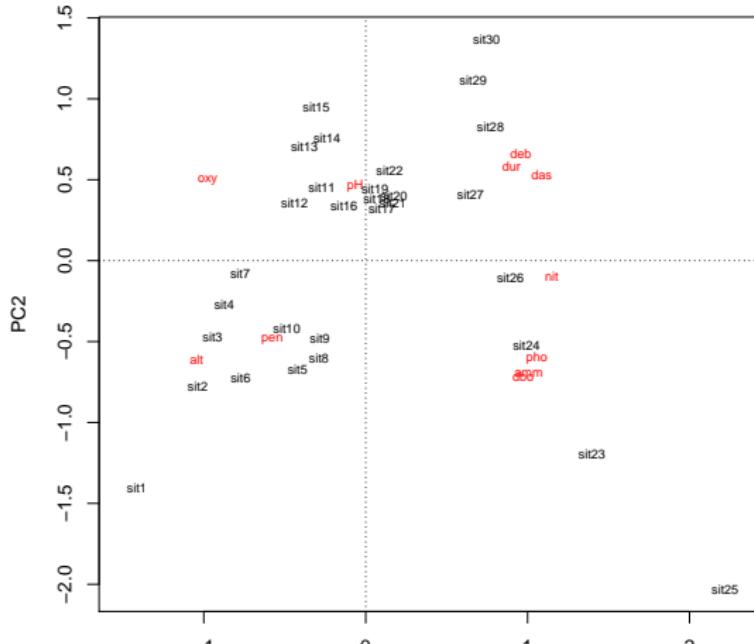
Unconstrained Ordination
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Constrained Ordination
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Permutation Tests

Principal Components Analysis (PCA) — How?

```
require(vegan)  
PCA <- rda(Denv, scale = TRUE)  
plot(PCA)
```



Datasets
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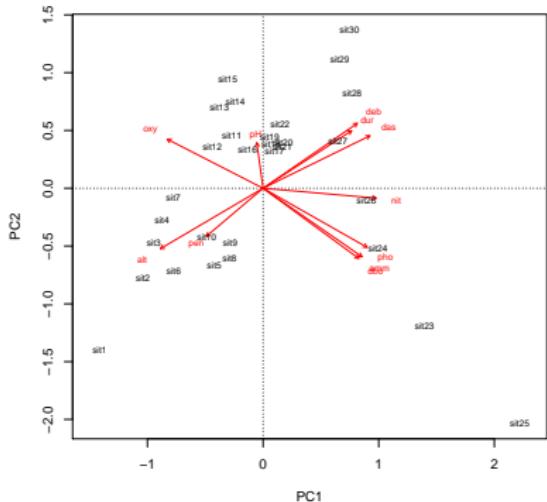
Unconstrained Ordination
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Permutation Tests

Principal Components Analysis (PCA) — Interpretation? (I)

biplot (PCA)



Datasets

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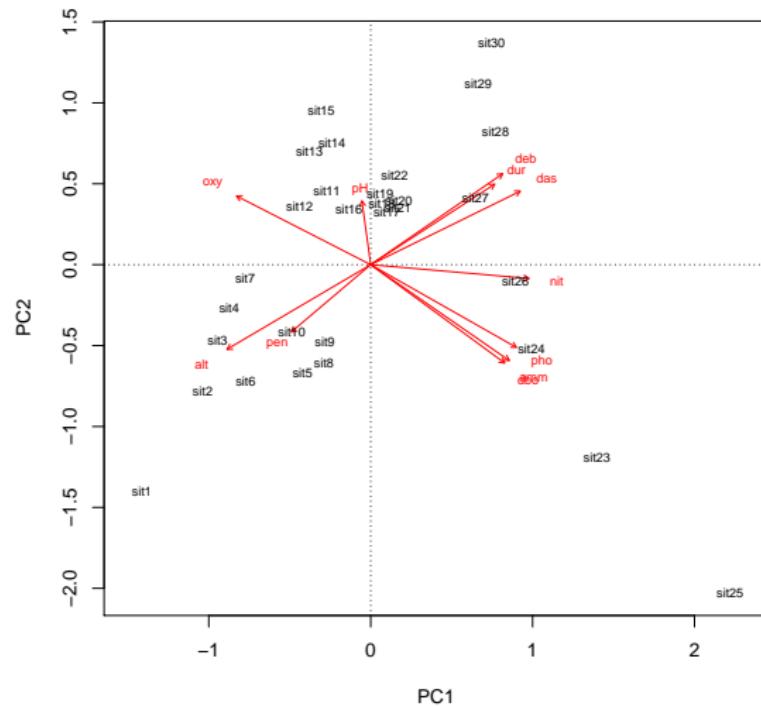
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Constrained Ordination

Permutation Tests

Principal Components Analysis (PCA) — Interpretation? (II)

biplot(PCA)



Datasets
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Unconstrained Ordination
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Permutation Tests

Your turn!

Load the Melbourne dataset (only environmental variables).

Exclude the variables ID, logCond and logmaxTU.

Perform a PCA.

Which variables are correlated?

What other gradients are present in this dataset?

Constrained Ordination

Constrained Ordination

- ▶ Redundancy analysis (RDA)
- ▶ Transformation-based RDA
- ▶ Distance-based RDA
- ▶ Permutation Tests

Datasets
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Unconstrained Ordination
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Constrained Ordination
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Permutation Tests

Your turn!

Using the doubs data.

Permutation Tests

Your turn!

Using the doubs data.