Ordination

Lecture 09.2: Dissimilarity

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Module: Multivariate Models

Readings

Required for class:

- NA

Optional:

- Anderson, T. M. (2018) Herbivory and eutrophication mediate grassland plant nutrient responses across a global climatic gradient. *Ecology*.

Distance Matrices and Dissimilarity

Reminder: We used distance measures (d_{jk}) to define the distance between two points in space, and we used many different ways to calculate these distances (e.g. Euclidean, Jaccard, Canberra, etc).

Another way to think distance is as dissimilarity: A distance matrix is a way to represent the difference, or *dissimilarity*, between multi-dimensional sets of data (i.e. two rows of a dataset).

Toy Example Revisited

```
## # A tibble: 4 x 5
##       a     b     c     d     e
##   <dbl> <dbl> <dbl> <dbl> <dbl>
## 1     0    10     5     0     0
## 2    10     2     1     1     3
## 3    50     0     0     5     4
## 4    50     0     0     5     4
```

Bray-Curtis distance (dissimilarity) matrix

```
##           1         2         3
## 2 0.8235294
## 3 1.0000000 0.2851446
## 4 1.0000000 0.2851446 0.0000000
```

- Plots 3 and 4 are identical ($Y_{ij} = Y_{ik}$), so distance/ dissimilarity $= 0$
- Plots 1 and 3, and 1 and 4 are completely different, so their dissimilarity $= 1$.
- Plots 2 and 3 are more similar to each other than plots 2 and 1, thus their distance/dissimilarity is 0.285 vs 0.823

Dissimilarity as a Dependent Variable

One thing that is useful is to examine how different treatments or environmental factors (etc) alter dissimilarity between plots.

- To do this, you need to calculate dissimilarity of communities and then use this as single dependent Y.
- This can also be called "turnover" because you are looking at how species change between plots (e.g. a dissimilarity of 1 = complete turnover, dissimilarity of 0 = no turnover).

Ecology, 99(4), 2018, pp. 822–831

Herbivory and eutrophication mediate grassland plant nutrient responses across a global climatic gradient

T. Michael Anderson,[1,21] Daniel M. Griffith,[2] James B. Grace,[3] Eric M. Lind,[4] Peter B. Adler,[5]

Experimental Design

How do herbivores and nutrients alter community dissimilarity?

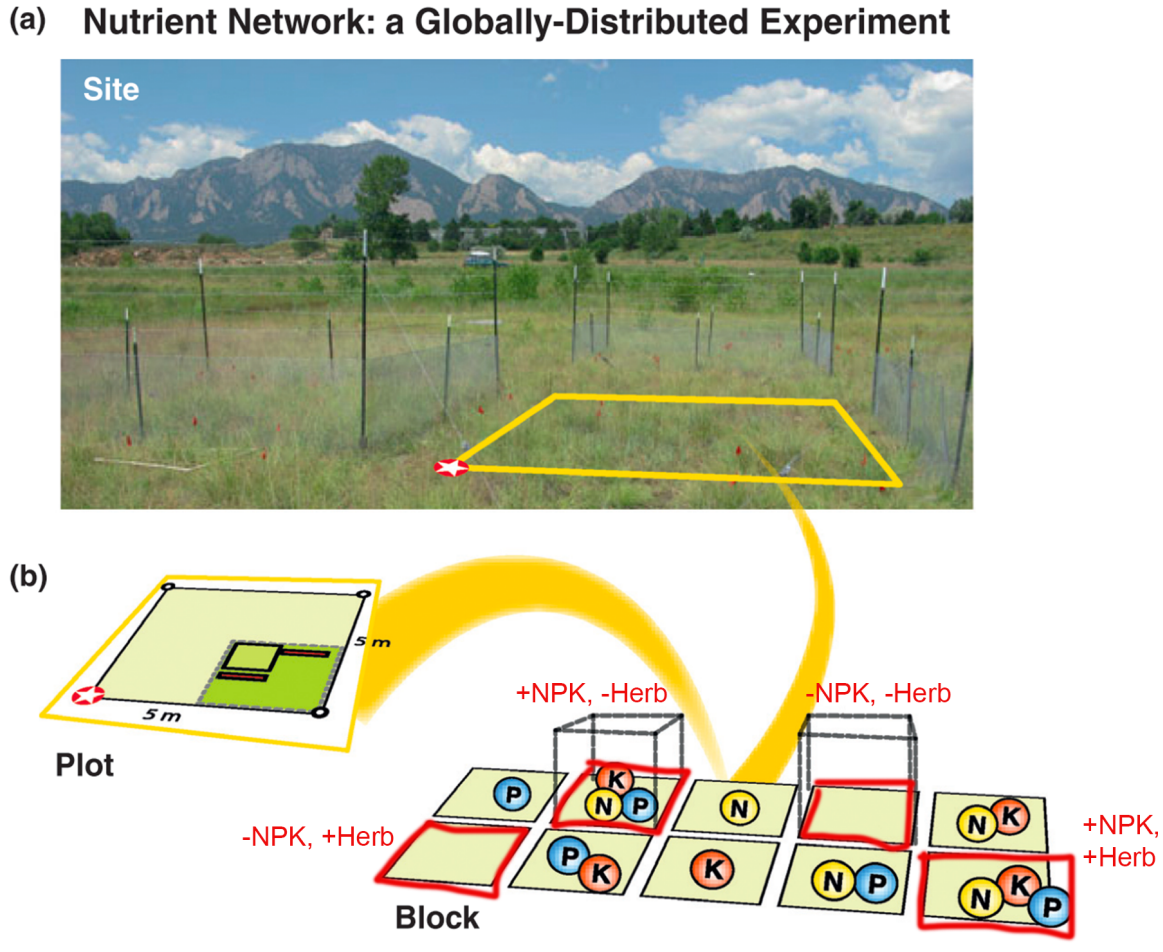
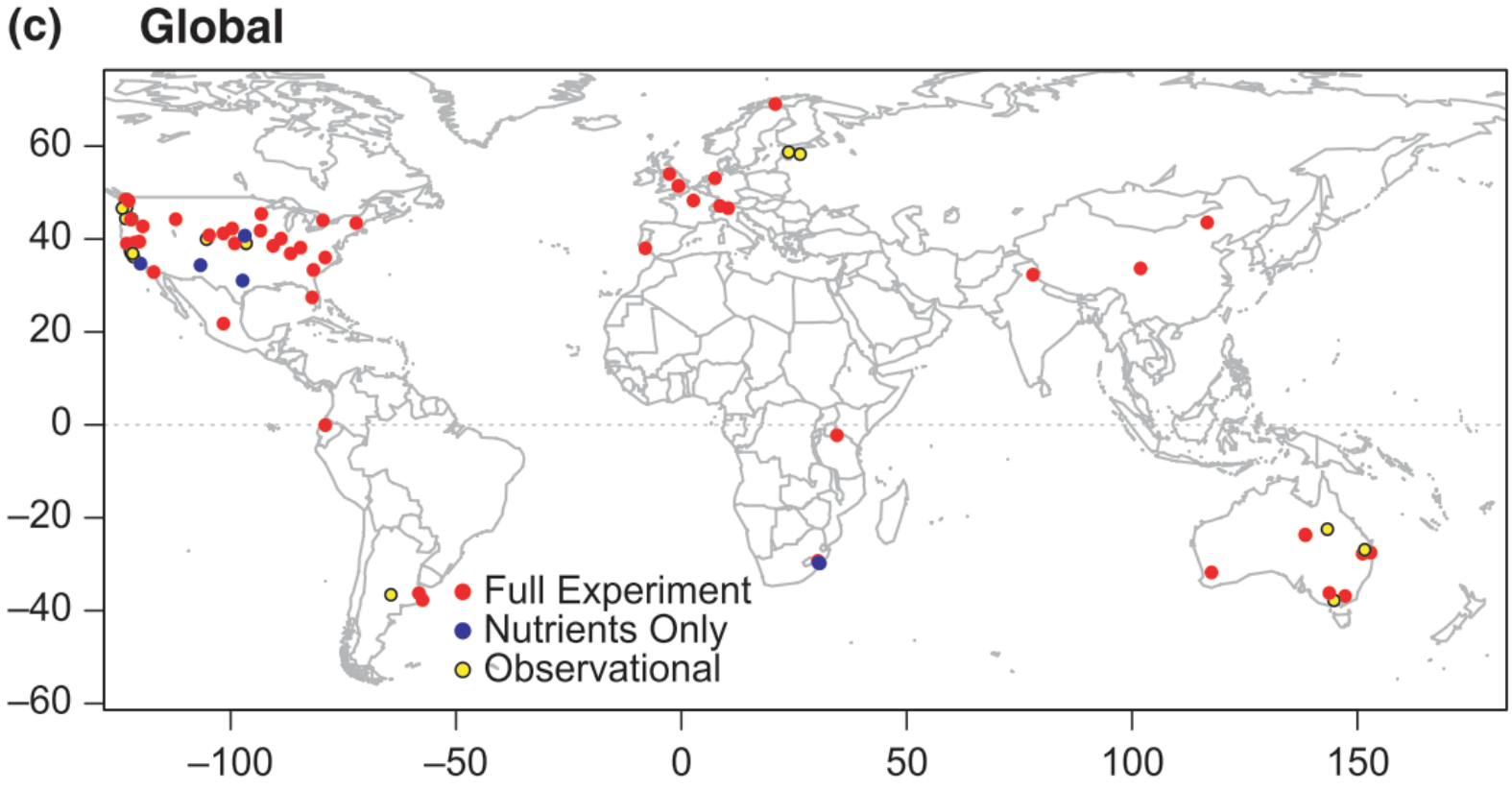


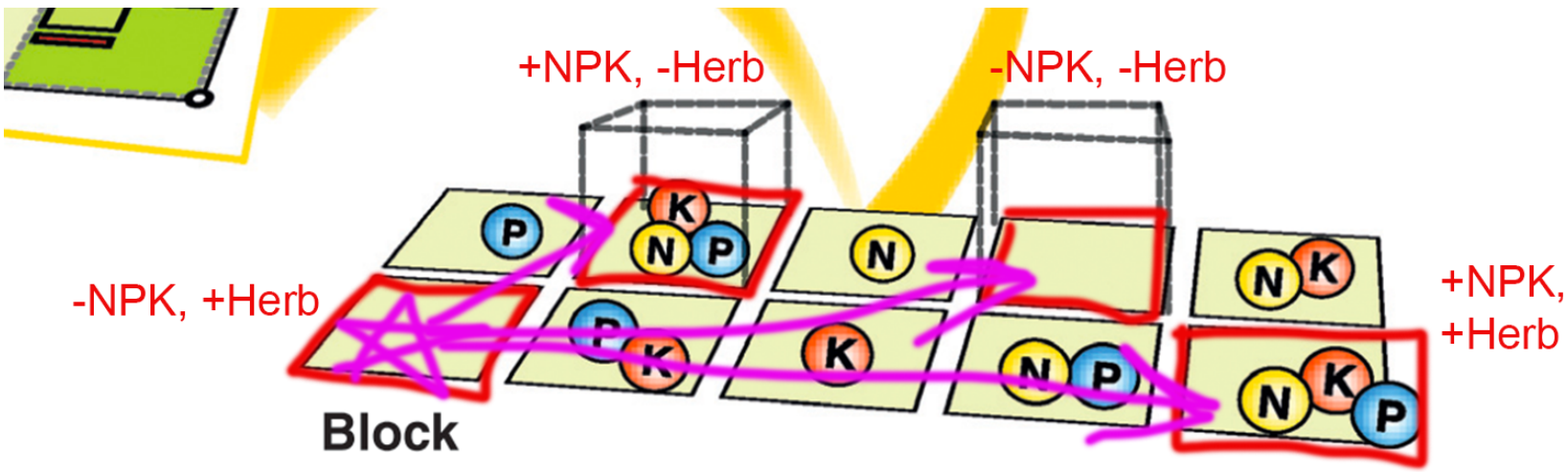
Figure 1: Borer et al. 2014 MEE

Experimental Design



Dissimilarity/Turnover Calculations

Calculate the dissimilarity (using Bray-Curtis, standardized by plot totals) for each trt plot to its control within a block.



Dissimilarity/Turnover Calculations

```
##   site_code block       trt year     dissimilarity
## 1   bnch.us     1   Control 2007                 0
## 2   bnch.us     1     Fence 2007 0.370069867027271
## 3   bnch.us     1       NPK 2007 0.498635700234786
## 4   bnch.us     1 NPK+Fence 2007 0.346089700247915
## 5   bnch.us     2   Control 2007                 0
## 6   bnch.us     2     Fence 2007 0.357916850950907
```

Dissimilarity ~ Treatment

```
model1 <- lmer(dissimilarity ~ trt + (1|year/site_code/block),
               data = results)
#Anova(model1, test.statistic = "F") - in library(car)
anova(model1)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##     Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## trt   1.41 0.70501     2 717.89  32.685 2.598e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Dissimilarity ~ Treatment