Navigation in the Ecological Space

2 – Assessing Explanatory Variables

Miguel Alvarez & Ildikó Orbán

GreenGaDe

About this Workshop

Timeslots

2^{nd} – 3^{rd} February 2024

- 09:00 – 12:00 Morning Session
- 13:30 – 16:30 Afternoon Session

10 – 15 min break

Trainers

Miguel Alvarez

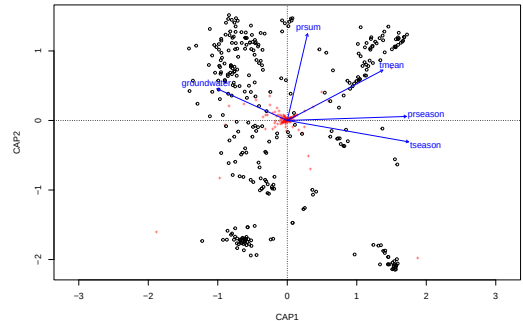
Ildikó Orbán

GreenGaDe

About this Workshop

Content

- Constrained Ordination
  - Linear
  - Unimodal
  - Distance-Based
- Permutation Analysis



GreenGaDe

About this Workshop

Disclaimer

- Licenced by Creative Commons 4.0 CC BY-SA
- It may contain a pinch of AI

About this Workshop

Navigation in the Ecological Space

Welcome to our Workshop!

Plant species composition as a response to environmental factors and anthropogenic disturbance is a central principle in vegetation science and biogeography. Assessing vegetation species composition as a response to environmental factors is not trivial, as most common modelling approaches are restricted to a single response variable and not multiple responses. Multivariate statistics, including indirect (unconstrained) and direct (constrained) ordination analysis, are tools to address this problem.

Homepage | GitHub | GitLab | Mastodon | LinkedIn | Email

https://kamapu.gitlab.io/multivar/

GreenGaDe

Gradient Analysis

Response Variables and Factors

$$\hat{y}_i = \beta_0 + \beta_1 x_{i1} + ... + \beta_n x_{in} + \epsilon_i$$

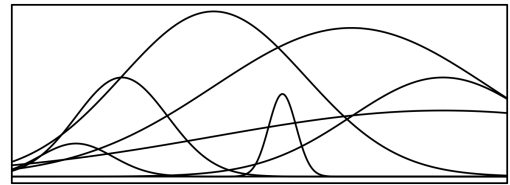
- Response (dependent variable)
- Factors (explanatory variables)

Gradient Analysis

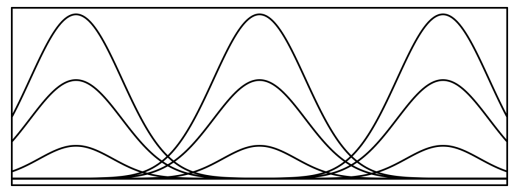
Henry A. Gleason
(1882–1975)

- Gleasonian Approach
  - Continuum Concept
  - Individualistic Behaviour of Plants
  - **Ecosystem**

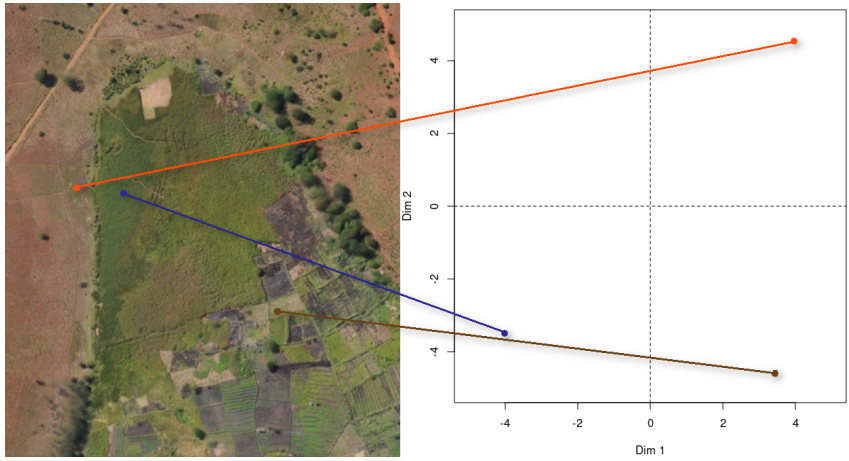
Continuum



Superorganismus



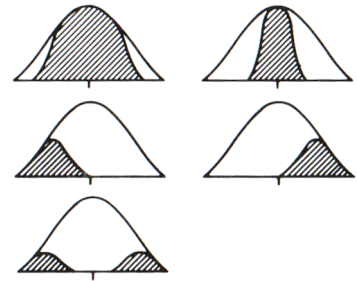
Gradient Analysis



GreenGaDe

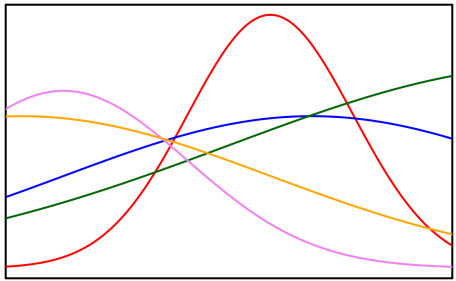
Gradient Analysis

- Physiological vs. Ecological Optimum
  - Tolerance
  - Competition (intra and interspecific)



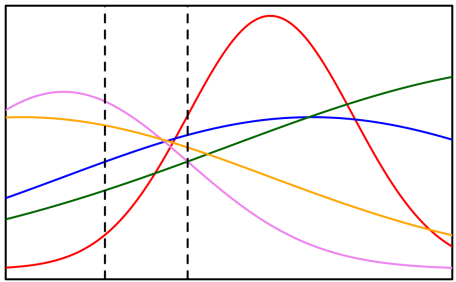
Ordination Analysis

Unimodal Response

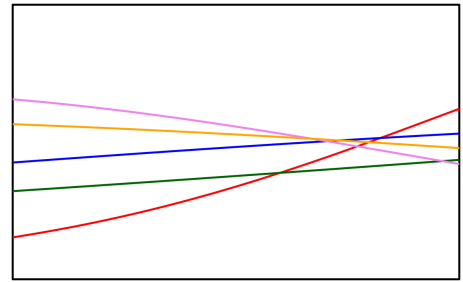


Ordination Analysis

Unimodal Response



Linear (Monotonic) Model



Constrained Ordination

	Indirect / Unconstrained Ordination	**Direct / Constrained / Canonical Ordination**
Linear Response	Principal Component Analysis (PCA)	Redundancy Analysis (RDA)
Unimodal Response	Correspondence Analysis (CA) Detrended Correspondence Analysis (DCA)	Canonical Correspondence Analysis (CCA)
Distance-Based	Principal Coordinates Analysis (PCoA) Non-Metric Multidimensional Scaling (NMDS)	Canonical Analysis on Principal Coordinates (CAP) Distance-Based Redundance Analysis (db-RDA)

GreenGaDe

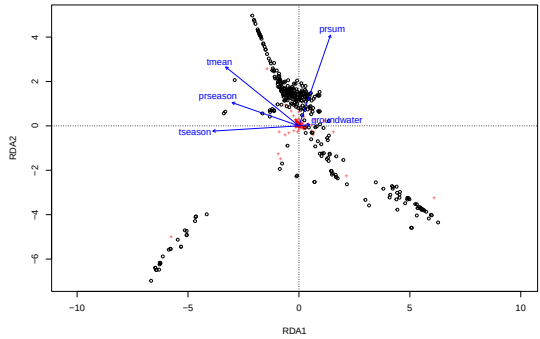
Constrained Ordination

$$\hat{y}_i = \beta_0 + \beta_1 x_{i1} + ... + \beta_n x_{in} + \epsilon_i$$

- Response Variable (Species Composition)
- Explanatory variables (Environment)
  - Multiple Linear Regression on scores

Redundancy Analysis (RDA)

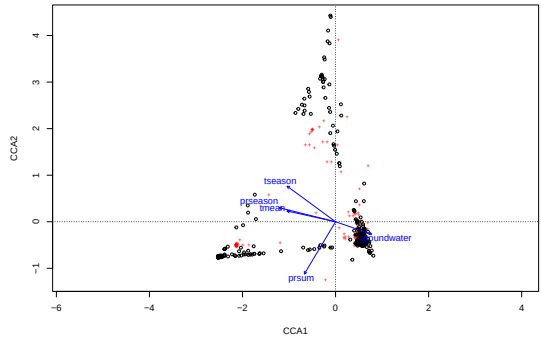
```
rda_ord <- rda(cross_tab ~ groundwater +
    tmean + tseason + prsum + prseason,
        data = wetlands$env)
plot(rda_ord)
```



GreenGaDe

Canonical Correspondence Analysis (CCA)

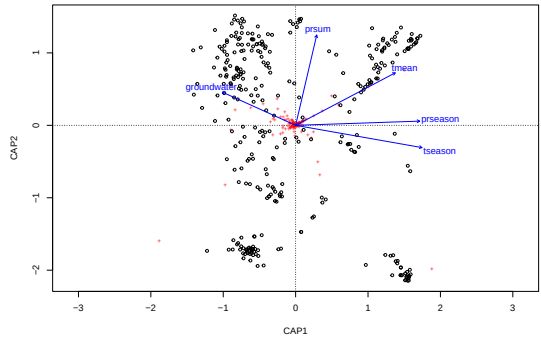
```
cca_ord <- cca(cross_tab ~ groundwater +
    tmean + tseason + prsum + prseason,
        data = wetlands$env)
plot(cca_ord)
```



GreenGaDe

Canonical Analysis on Principal Coordinates (CAP)

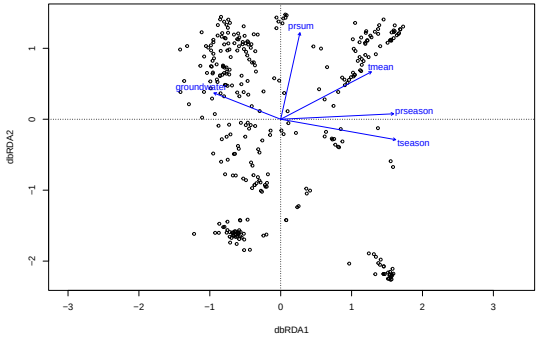
```
cap_ord <- capscale(cross_tab ~ groundwater +
    tmean + tseason + prsum + prseason,
        data = wetlands$env, dist = "bray")
plot(cap_ord)
```



GreenGaDe

Distance-Based Redundancy Analysis (db-RDA)

```
dbrda_ord <- dbrda(cross_tab ~ groundwater +
    tmean + tseason + prsum + prseason,
        data = wetlands$env, dist = "bray")
plot(dbrda_ord)
```



GreenGaDe

Thank You!

GreenGaDe