

Canoco 5 – a short introduction

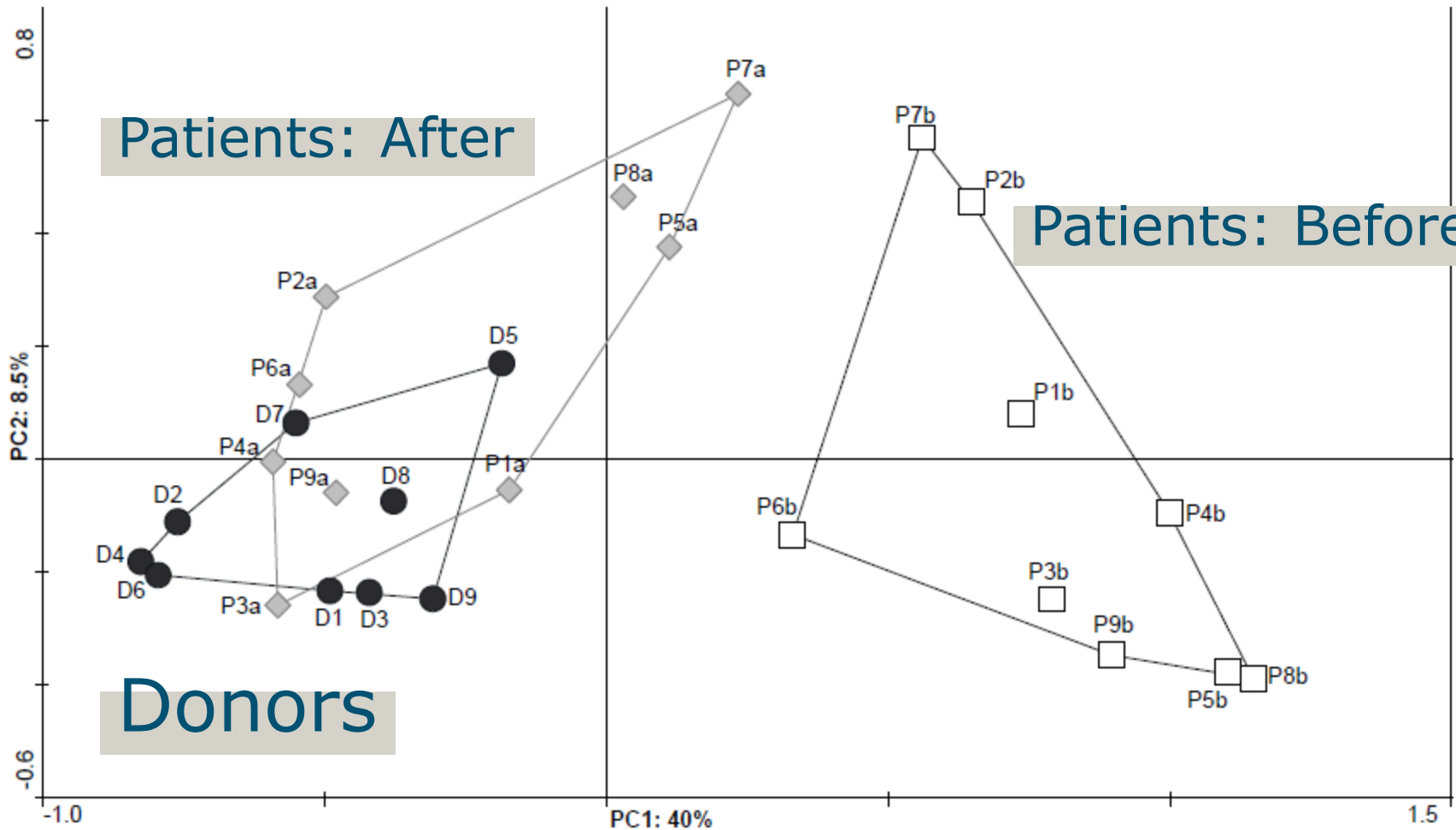
Software for multivariable data analysis and visualization
Canoco shows it!

Cajo J.F. ter Braak and Petr Šmilauer



Ex1: Comparison of microbiota among three groups

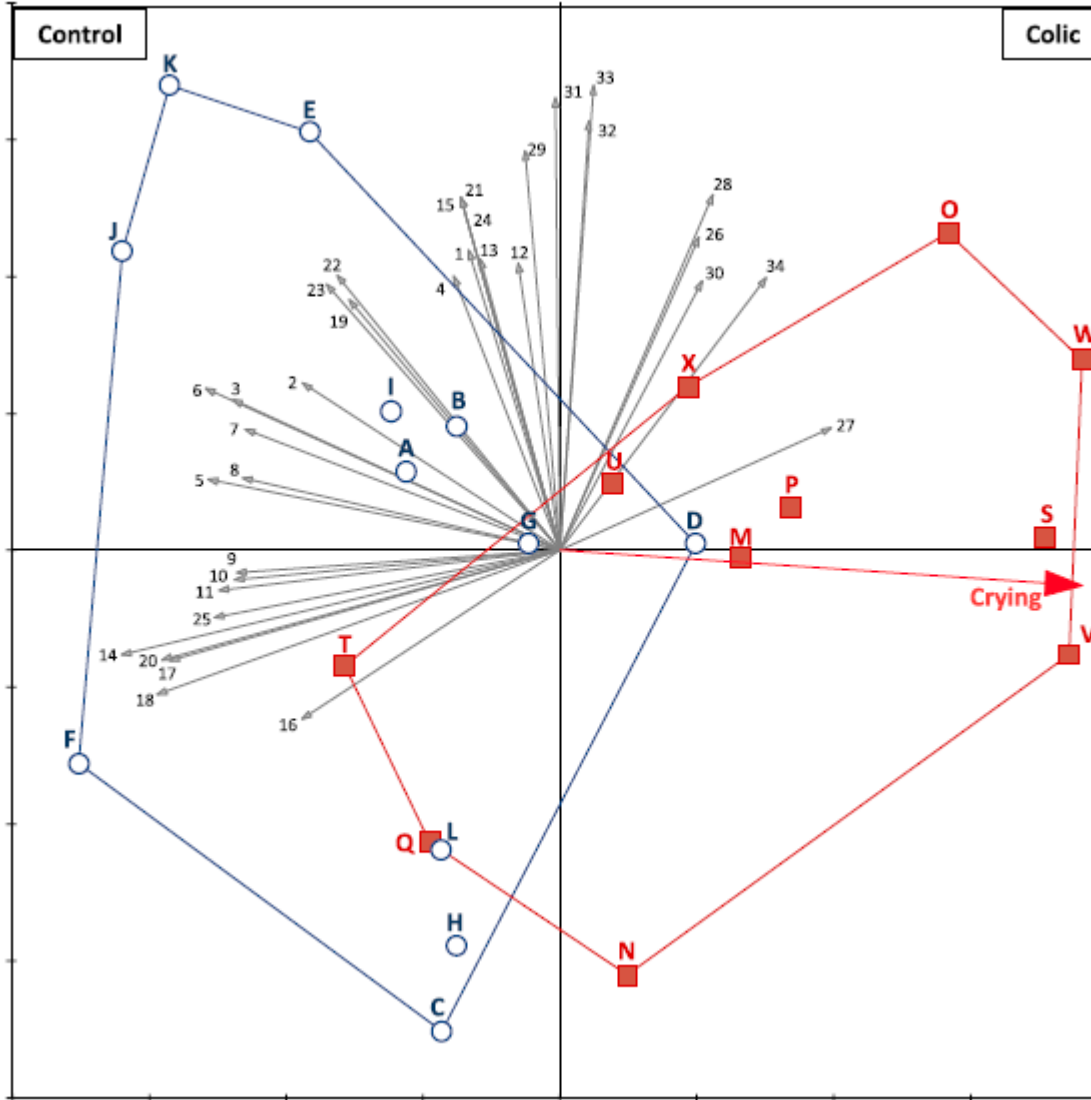
Unconstrained (PCA)



Feces transplant study: van Nood et al. 2013 NEJM
Data: **microbiota taxa** (Susana Fuentes, W. de Vos)

Ex2: Comparison among two groups (1)

Constrained (RDA)



- Extension of t-test
- Horizontal (constrained) axis = difference of Control and Colic
- Vertical (unconstrained) axis = main residual pattern
- Correlation with Crying of babies

Ex2: Comparison among two groups (2)

We see three types of data in this example

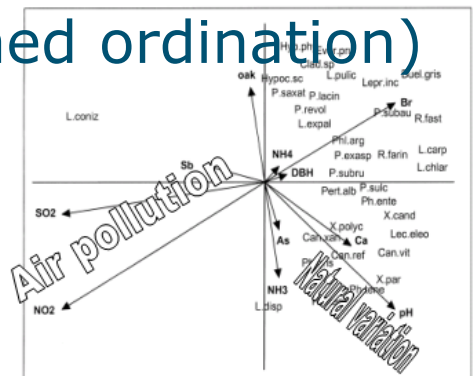
- Response data (the main/focal data :
 - Amounts of 33 microbiota taxa
- Explanatory data:
 - Treatment, a factor with 2 levels (Control and Colic)
- Supplementary data:
 - Crying

Roles of data tables

- Response data (main data table)
 - to be visualized, perhaps in combination with others
- Supplementary data
 - to interpret the response data
- Explanatory data
 - to explain the response data
- Covariate data (for advanced users)
 - to account or adjust for.
 - to enable detection of structure in response *after* accounting for the variation explained by these covariates

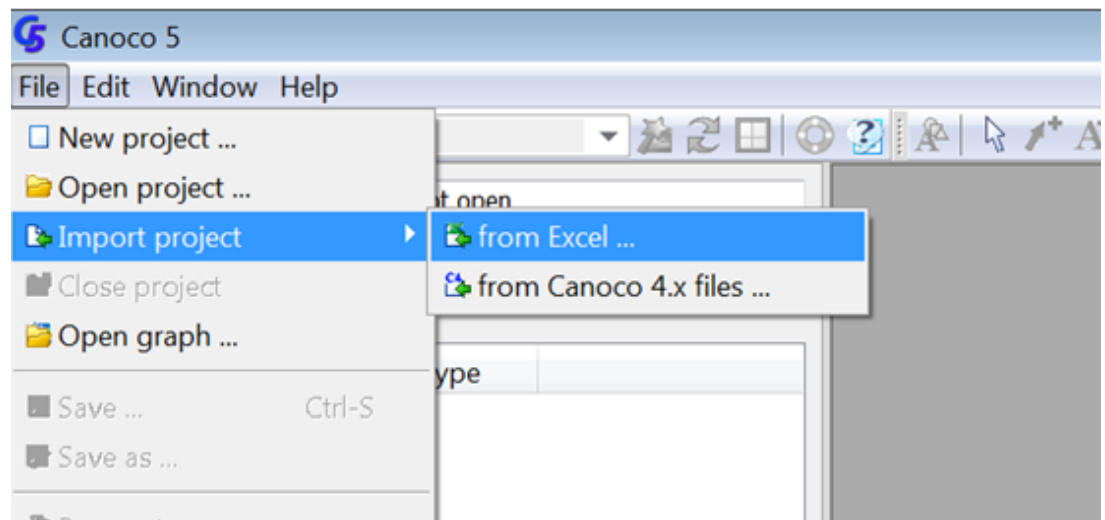
Research questions and methods in Canoco

- Derive patterns and relationships from data
 - From field or laboratory
 - From designed experiments or surveys
 - **Many noisy variables**, non-linear relationships
- Key methods
 1. Dimension reduction (ordination, factor analysis, multidimensional scaling)
 2. Regression analysis, also non-linear
 3. Combination of 1 and 2 (constrained ordination)
 4. Visualization of results
 5. Statistical testing by permutation



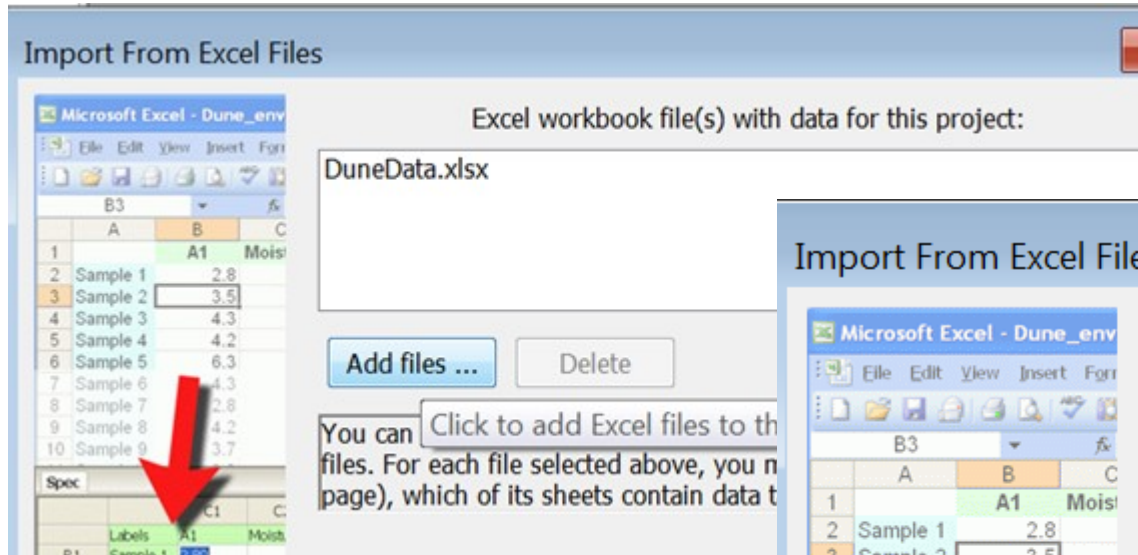
Starting a new Canoco project (1)

- Canoco 5 focuses on research questions on a set of data
- A Canoco 5 project thus consists of
 - one or more data tables
 - analyses on these data
- Easiest to start a new project with
File|Import project|from Excel... (Alt-F-I-Enter)

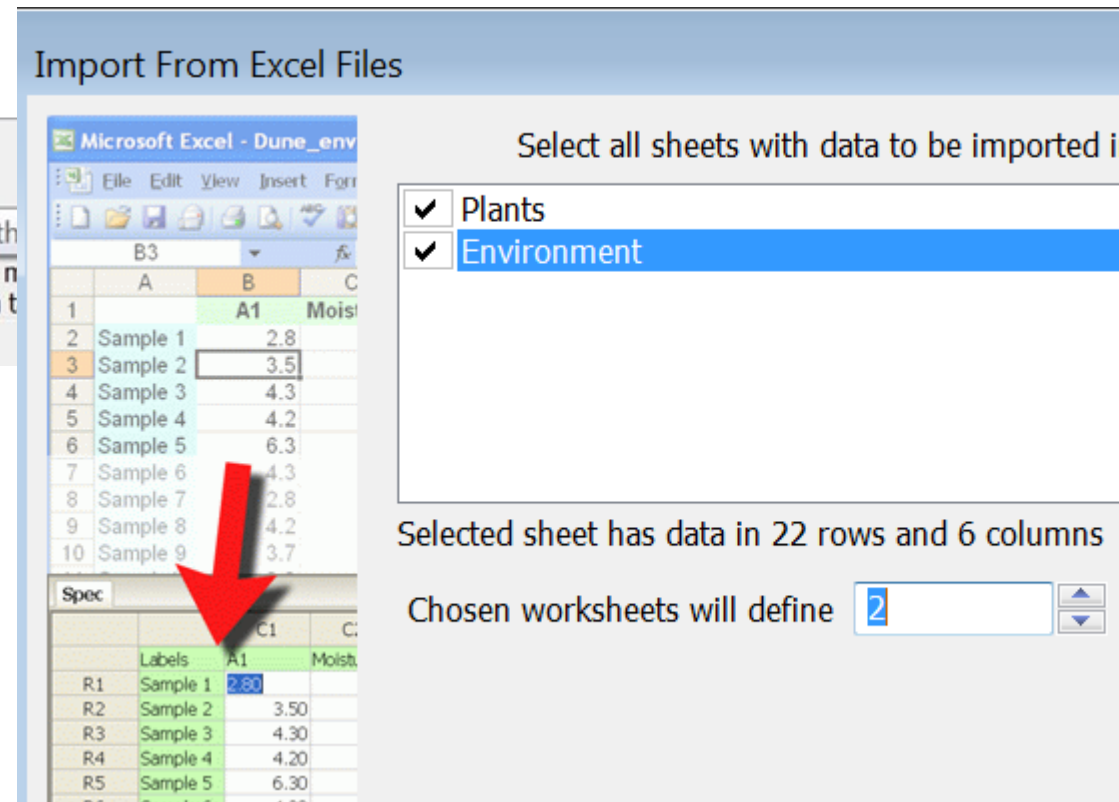


Starting a new Canoco project (2)

- Select one or more Excel files, here 1



- Select the number of project data tables, here 2



- Excel file can contain more than one sheet
- Each sheet can give ≥ 1 data tables

Starting a new Canoco project (3a)

Give names to YOUR units and variables

- choose from list or
- start typing
 - singular, then
 - plural

Import From Excel Files: Table 1/2

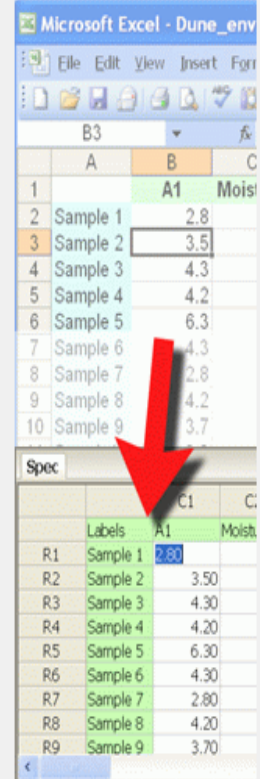


Table specified here will become the main (primary) data table of this project.

Table identity

Each observational **unit** is a
 multiple units are called

Each **variable** in the table is a
 multiple variables are called

Table name:

Data Sources

Data for table are in a single sheet split over more sheets

Choose sheet with data:

Environment

Selected sheet has data in 22 rows and 31 columns

Data are transposed, with plant species arranged in rows

For numeric data, empty cells are zeros missing values

This table represents general compositional data

Import all plant species as factors

Starting a new Canoco project (3b)

Give names to YOUR units and variables

Empty cells: 0 or mis

Data kind is

- General or

- Compositional:

 - row sum has meaning

 - variables measured on the same scale

The right choice helps to select suitable methods

Import From Excel Files: Table 1/2

Microsoft Excel - Dune_env

	A	B	C
1		A1	Moist
2	Sample 1	2.8	
3	Sample 2	3.5	
4	Sample 3	4.3	
5	Sample 4	4.2	
6	Sample 5	6.3	
7	Sample 6	4.3	
8	Sample 7	2.8	
9	Sample 8	4.2	
10	Sample 9	3.7	

Spec		C1	C2
	Labels	A1	Moist
R1	Sample 1	2.80	
R2	Sample 2	3.50	
R3	Sample 3	4.30	
R4	Sample 4	4.20	
R5	Sample 5	6.30	
R6	Sample 6	4.30	
R7	Sample 7	2.80	
R8	Sample 8	4.20	
R9	Sample 9	3.70	

Table specified here will become the main (primary) data table of this project.

Table identity

Each observational unit is a meadow

multiple units are called meadows

Each variable in the table is a plant species

multiple variables are called plant species

Table name: Plants

Data Sources

Data for table are in a single sheet split over more sheets

Choose sheet with data:

- Plants
- Environment

Selected sheet has data in 22 rows and 31 columns

Data are transposed, with plant species arranged in rows

For numeric data, empty cells are zeros missing values

This table represents general compositional data

Import all plant species as factors

Starting a new Canoco project (5)

Result: two project data tables (Plants and Environment) and offer for starting analysis

Data tables:

you can

- View
- Edit
- Copy
- Export
- Change kind/name etc.

Plants		Environment									
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
	Labels	Achillea mi	Agrostis st	Aira praec	Alopecurus	Anthoxanth	Bellis pere	Bromus ho	Chenopodi	Cirsium an	Eleocharis
R1	1	1									
R2	2	3				2		3	4		
R3	3		4		7		2				
R4	4		8		2		2	3		2	
R5	5	2									
R6	6	2									
R7	7	2									
R8	8										
R9	9										
R10	10	4									
R11	11										
R12	12										
R13	13										
R14	14										
R15	15										
R16	16										
R17	17	2									
R18	18										
R19	19										
R20	20										
[R21]											
[R22]											
[R23]											
[R24]											

Introductory Analysis

Do you want to setup quickly a starting analysis for your project?

Summary Log Cases Resplots Suppliers Graph 1 Graph 2

Analysed Data Summary

Cases: 27 samples

Response vars: 22 species

Supplementary vars: 24 environmental variables [24=14]

Summary of Results

Method: PCA with supplementary variables

Total variation is 2423.836, supplementary variables account for (adjusted explained variation is 35.8%)

Statistics: Axis 1 Axis 2 Axis 3 Axis 4

Eigenvalues: 0.2220 0.1264 0.0921 0.0804

Explained variation (cumulad): 22.36 41.43 50.74 58.81

Correlation response supple: 0.9438 0.9400 0.8977 0.7653

If so, select analysis type and click Yes button:

- unconstrained ordination of plant species, environmental variables projected
- constrained ordination of plant species, using all environmental variables
- constrained ordination of plant species, with selection of environmental variables

Show this dialog box after each suitable project import

Starting a new Canoco project (6)

Accepting the offer and all default choices leads to

-Summary of DCA analysis

-Two graphs

Save your project!

- File Save.. or
- Ctrl-S

The screenshot shows the Canoco 5 software interface. The title bar reads "Canoco 5 - [Analysis Unconstrained-suppl-vars]". The menu bar includes File, Edit, Project, Data, Analysis, Graph, Window, and Help. The toolbar contains various icons for file operations and analysis. The main window is divided into several panels:

- Project:** DuneIntro.c5p
- Data tables:** A table with columns Table, Cases, Vars, and Type. The first row is "Plants" with 20 cases and 30 variables of type "compos.". Below the table are "Add table ..." and "Delete table" buttons.
- Analyses:** A list box containing "Unconstrained-suppl-vars".
- Summary:** A panel with tabs for "Summary", "Graph 1", and "Graph 2". It contains an "Analysed Data Summary" section with the following information:
 - Cases: 20 meadows
 - Response vars: 30 plant species
 - Supplementary vars: 5 environmental variables [DF=7]
- Summary of Results:** A section with the following text:
 - Method: DCA with supplementary variables
 - Total variation is 2.11526, supplementary variables account for 55.7% (adjusted explained variation is 29.8%)
- Summary Table:** A table with columns for Statistic, Axis 1, Axis 2, Axis 3, and Axis 4. The rows are:

Statistic	Axis 1	Axis 2	Axis 3	Axis 4
Eigenvalues	0.5360	0.2869	0.0814	0.0481
Explained variation (cumulative)	25.34	38.90	42.75	45.03
Gradient length	3.70	3.12	1.31	1.48
Pseudo-canonical correlation (suppl.)	0.8549	0.8748	0.8051	0.8070
- Buttons:** "Copy" and "Details" buttons are located below the Summary Table.

A red circle highlights the "Pseudo-canonical correlation (suppl.)" row in the Summary Table, and a blue arrow points from this row to the text "Species-environment correlation" at the bottom of the interface.

Starting a new Canoco project (6)

Accepting the offer and all default choices leads to

-Summary of DCA analysis

-Two graphs

To view the data again, click Plants

Save your project!

- File Save.. or
- Cntr-S

The screenshot shows the Canoco 5 software interface. The title bar reads "Canoco 5 - [Analysis Unconstrained-suppl-vars]". The menu bar includes "File", "Edit", "Project", "Data", "Analysis", "Graph", "Window", and "Help". The toolbar contains various icons for file operations and analysis. The main window is divided into several panels:

- Project:** DuneIntro.c5p
- Data tables:** A table with columns "Table", "Cases", "Vars", and "Type". The "Plants" row is highlighted with a red circle. The table contains: Plants | 20 | 30 | compos.
- Analyses:** A list box containing "Unconstrained-suppl-vars".
- Summary:** A panel showing analysis results. It includes sections for "Analysed Data Summary", "Summary of Results", and "Summary Table".

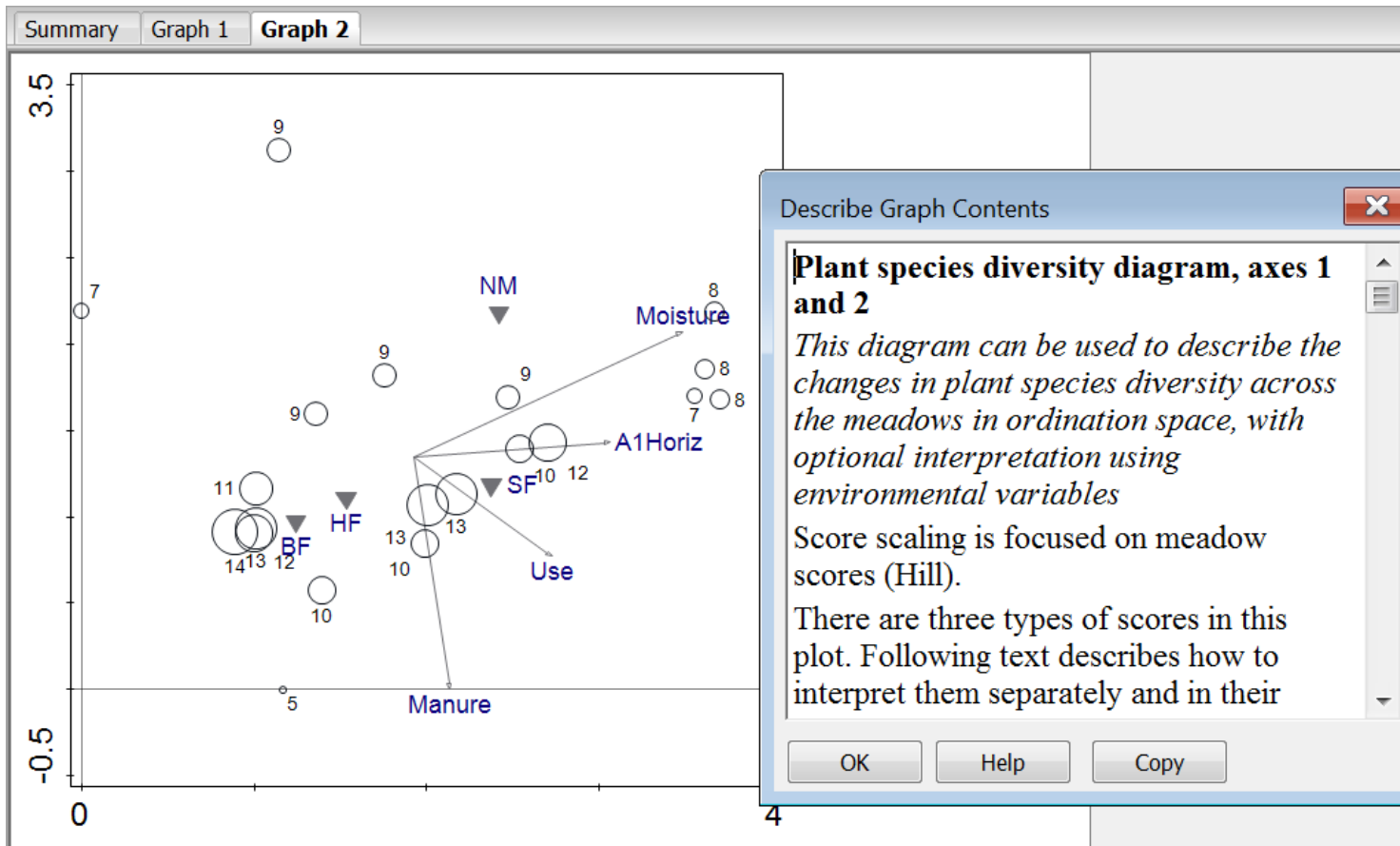
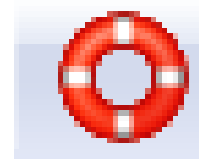
The "Summary of Results" section indicates: "Method: DCA with supplementary variables", "Total variation is 2.11526, supplementary variables account for 55.7% (adjusted explained variation is 29.8%)".

The "Summary Table" is as follows:

Statistic	Axis 1	Axis 2	Axis 3	Axis 4
Eigenvalues	0.5360	0.2869	0.0814	0.0481
Explained variation (cumulative)	25.34	38.90	42.75	45.03
Gradient length	3.70	3.12	1.31	1.48
Pseudo-canonical correlation (suppl.)	0.8549	0.8748	0.8051	0.8070

Buttons for "Copy" and "Details" are located below the table. At the bottom of the interface, there are buttons for "New ...", "Modify ...", "Re-analyze", "Hide", "Clear", and "Delete".

Inspecting a graph with Describe Contents



All scores are available too:

Edit | Settings | Canoco5 Options:

- Click  on the toolbar 

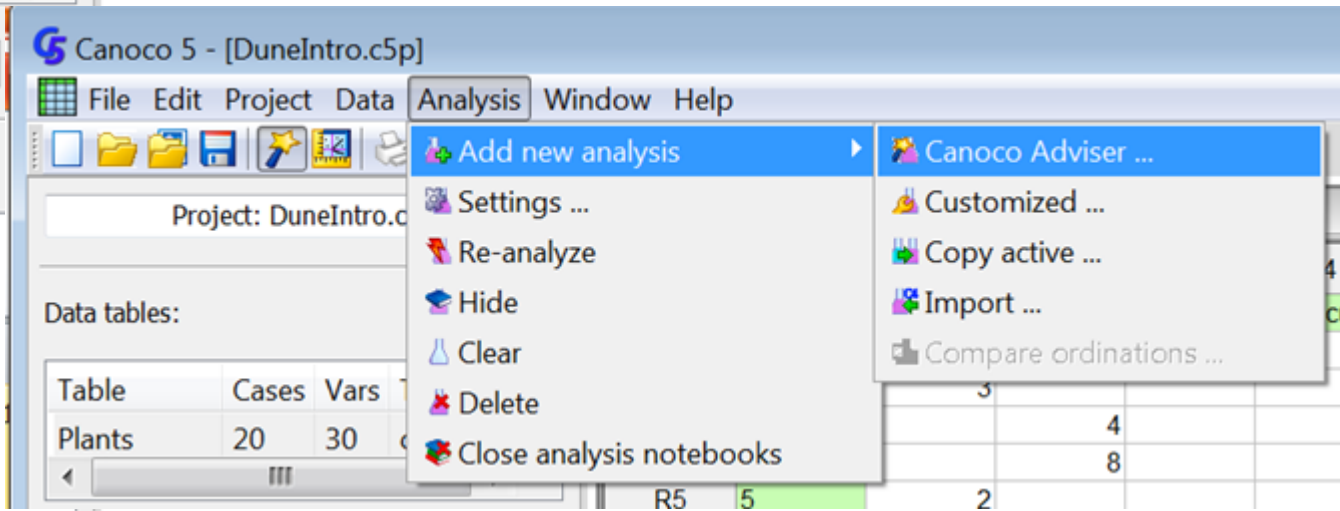
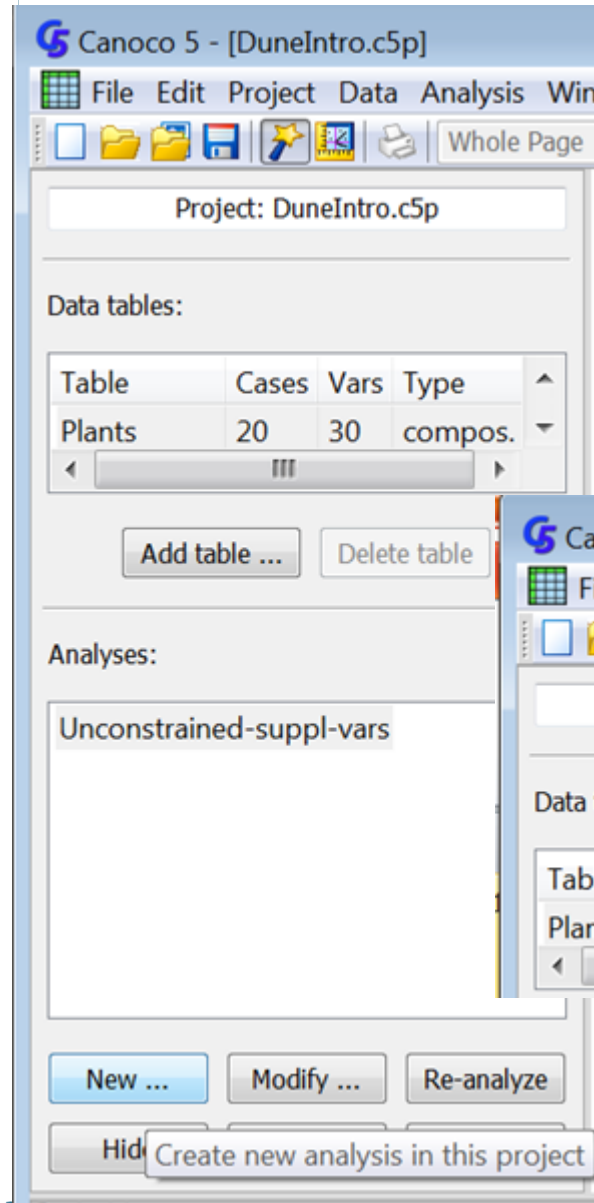
Summary	Log	Cases	RespVars	SupplVars	Graph 1	Graph 2							
			Resp.1	Resp.2	Resp.3	Resp.4	RespW	RespN2	Tol.1	Tol.2	Tol.3	Tol.4	Tol4
Achillea millefolium			-0.3561	-0.8570	-0.6661	-0.1861	16.0000	6.0952	1.3641	1.9130	1.2816	0.7240	138.6271
Agrostis stolonifera			3.6										4.7858
Aira praecox			-0.7										4.4872
Alopecurus geniculatus			3.0										6.8240
Anthoxanthum odoratum			-0.5796	2.7109	-0.1809	0.0430	21.0000	5.7273	1.4568	1.4038	0.8880	0.5835	114.2609
Bellis perennis			1.0092	0.5036	-0.9428	-0.5007	13.0000	5.8276	0.6525	0.6176	1.4455	1.0899	101.0523
Bromus hordaceus			0.5673	-0.4497	-2.3301	0.2091	15.0000	4.5918	0.8303	1.3136	2.6773	0.3196	155.6025
Chenopodium album			3.0359	1.3324	-2.3487	-1.8633	1.0000	1.0000	0.4963	0.0526	2.8354	1.8633	171.4669
Cirsium arvense			2.1552	2.0161	-4.5330	2.2143	2.0000	1.0000	0.1464	0.9517	4.5330	1.7246	247.2326

- Click again to hide the score tabs

Adding a new analysis to the project (1)

By :

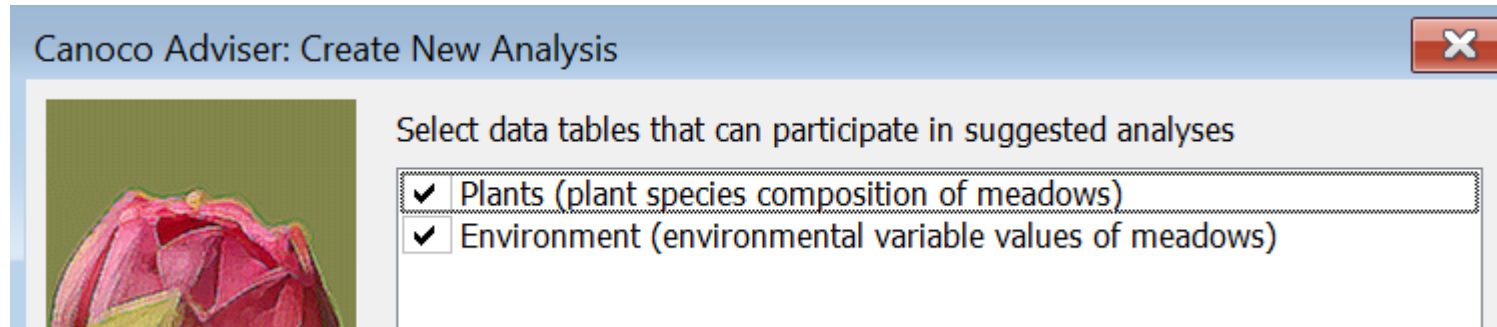
- *New...* (under Analyses) or
- *Analysis | Add new analysis | Canoco Adviser...* (Alt-a-a-Enter)



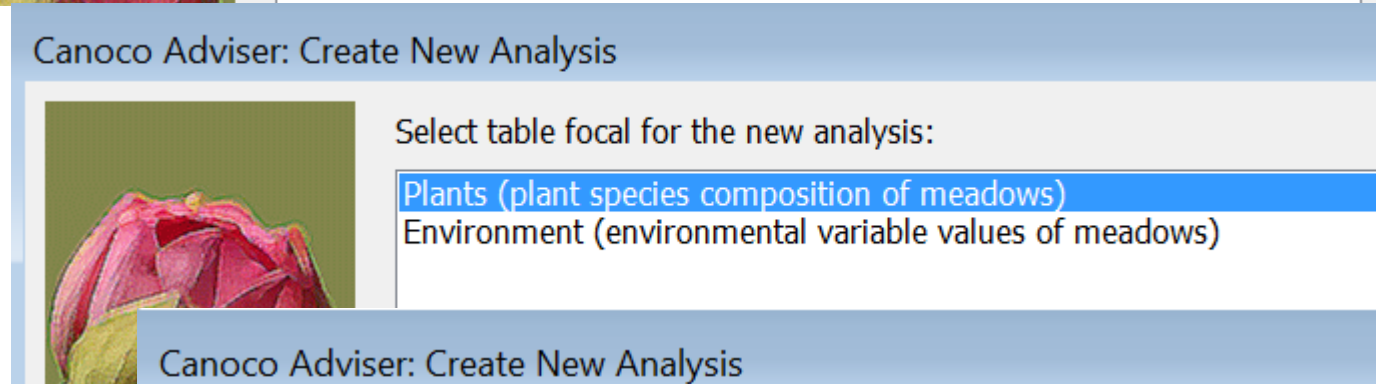
Adding a new analysis to the project (2)

Select:

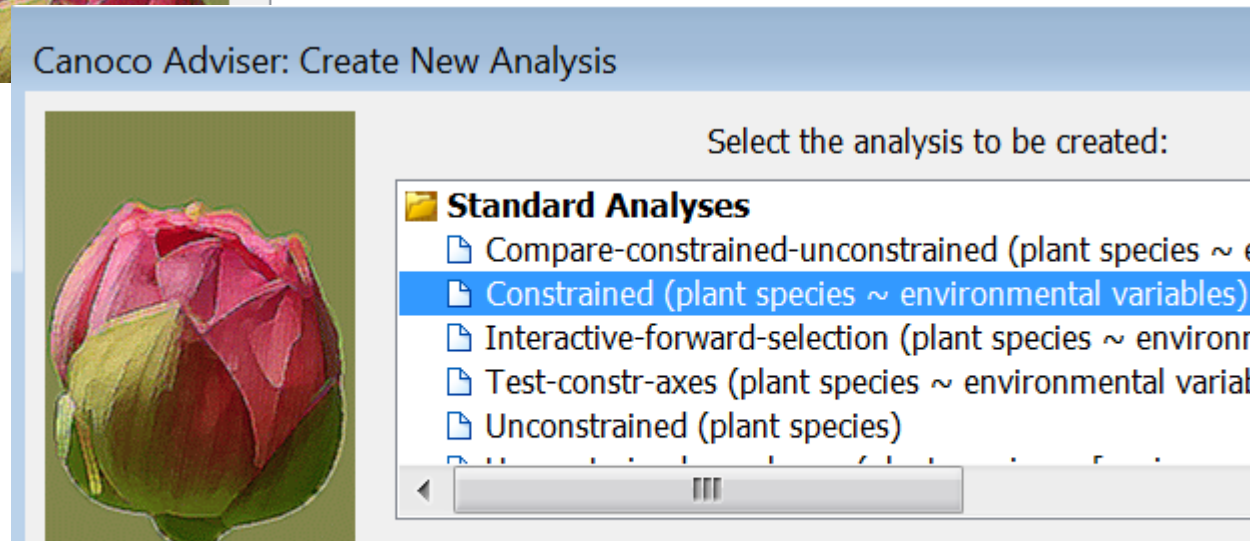
1. Tables



2. Focal table



3. Template for analysis

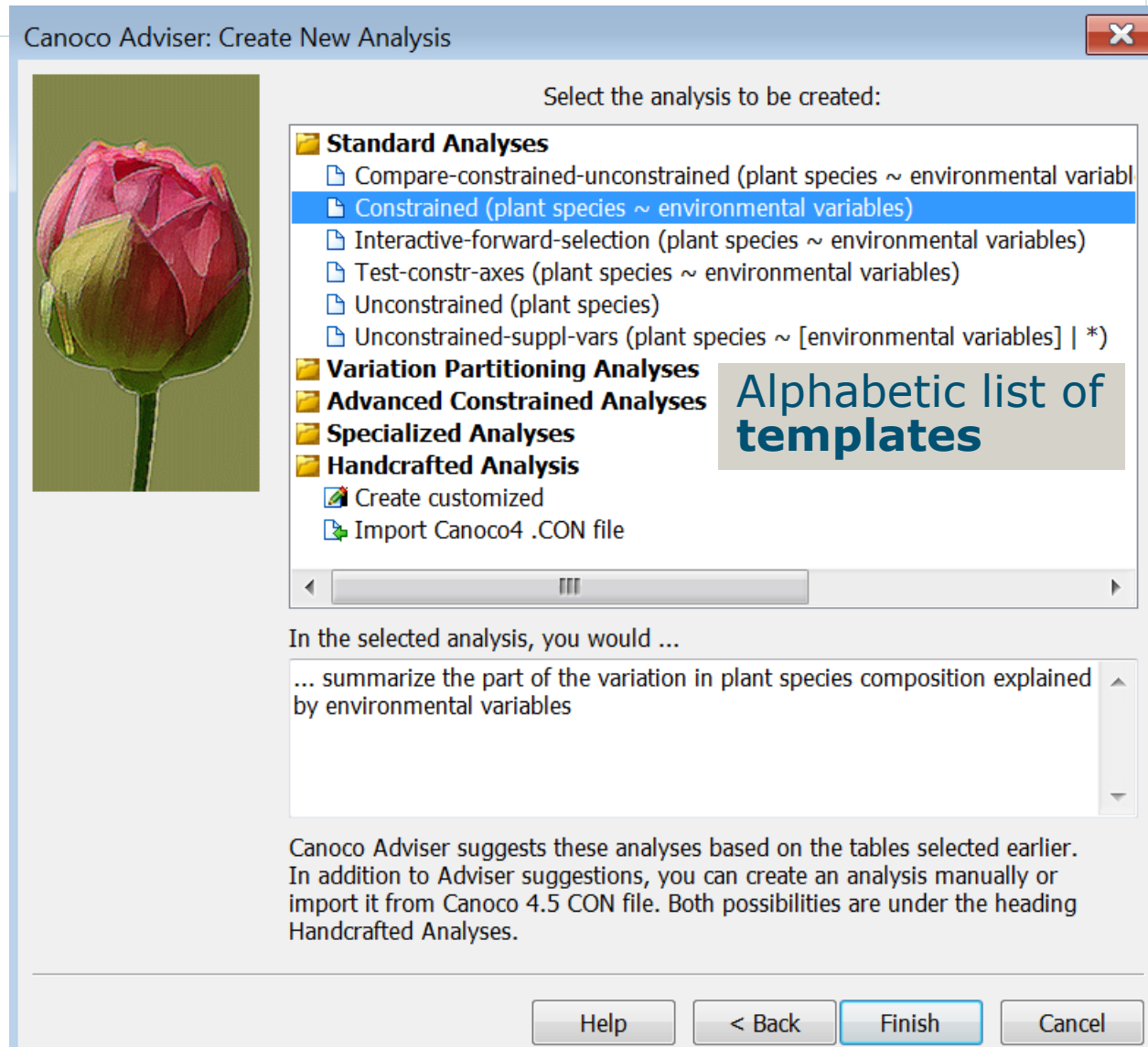


Adding a new analysis to the project (3)

3. Select **template**

-double click on bold terms to fold/unfold

(Can enlarge dialog window to see all)



Adding a new analysis to the project (4)

Standard analyses:

- Constrained: response variables \sim predictors
- Unconstrained: response variables
response variables \sim [supplementary variables]
- Compare constrained – unconstrained
- Test constrained axes
- Interactive forward selection of predictors
 - See also: Summarize effects of expl variables

See Advanced ... for constrained analysis with covariates

Adding a new analysis to the project (5)

Standard analyses:

Ordination method

Method	Linear	Unimodal
Unconstrained	<input type="radio"/> PCA	<input type="radio"/> CA (DCA)
Constrained	<input checked="" type="radio"/> RDA	<input checked="" type="radio"/> CCA

PCA: Principal component analysis

RDA: Redundancy analysis

CA (DCA): Correspondence analysis (Detrended)

CCA: Canonical correspondence analysis

Adding a new analysis to the project (6)

Test or Explore Predictor Effects

- Not performed
- All constrained axes test
- First constrained axis test
- Both above tests performed
- Forward selection of expl. variables
- Summarize effects of expl. variables

Permutation Test Parameters

- Unrestricted permutations
 - Time series or linear transects
 - Rectangular grids
 - Hierarchical design
 - Read from file
 - Disable random shifts from mirror
- Number of permutations:
- Random number generator seeds:
 and
- Blocks defined by covariates
 - Leverage correction of residuals



Summarize effects of expl. variables.

Dune meadow data

■ Plant species ~ Environment (CCA)

Term Effects

P values correction: False discovery rate

Simple Effects

Name	Explains %	pseudo-F	P	P(adj)	Copy
Moisture	19.4	4.3	0.002	0.016	
Management.NM	15.0	3.2	0.004	0.016	
Manure Amount	11.3	2.3	0.016	0.04267	

Conditional Effects

Name	Explains %	pseudo-F	P	P(adj)	Copy
Moisture	19.4	4.3	0.002	0.008	
Management.NM	12.2	3.0	0.002	0.008	
A1 horizont	6.7	1.7	0.06	0.16	

Term Effects

P values correction: False discovery rate

Simple Effects

Name	Ex				P
Moisture	19.4	4.3	0.002	0.016	

Forward selection of expl. variables

- Color code for significance
- FDR testing on-line, but only for viewed variables
 - Tip: increase window size to get correct FDR

Forward Selection Step

Candidate Terms

Name	Contribution %	F	P	P(adj)
Moisture	34.9	4.3	0.002	0.016
Management.NM	27.0	3.2	0.004	0.016
Manure Amount	20.3	2.3	0.016	0.04267
A1 horizont	19.1	2.1	0.032	0.064
Management.SF	16.7	1.8	0.058	0.0928
Management.HF	12.5	1.4	0.17	0.22667
Management.BF	11.9	1.3	0.228	0.26057
Use Type	10.9	1.2	0.294	0.294

Test Include Stop Help

Include whole factor

Term Contribution

All considered variables explain together 55.7% of total variation
Out of this variation, the highlighted term would contribute 34.9%

Selected Terms

Order	Name	P	P(adj)
-------	------	---	--------

P values correction: False discovery rate ▼

Canoco Adviser


On the basis of the data properties the Adviser suggests

-  Transformation and standardization of variables


right-click on top-left cell
in data sheet

Or use

*Data | Default
transformation and ...*

C5	C6	[C7]	[C8]
Manure Amount [PO4]			
4	1000		
	100		
4	10		
4	1		
2	923		

Canoco5


 Log transformation is suggested by Canoco Adviser for 1 environmental variable. After you close the Variable Transformations dialog, suggested transformations will be stored and used in the analyses.

Do not show this dialog again

OK Help

Canoco Adviser

On the basis of the data properties the Adviser suggests

-  Transformation and standardization of variables
- Common analyses via templates
- Choice between Linear and Unimodal

Ordination method

Method

Linear

Unimodal

Unconstrained PCA

CA (DCA)

Constrained RDA

CCA

Response data are compositional and have a gradient 3.7 SD units long, so unimodal method is suggested, but linear one would be also a good choice

Re-advise

Methods in Canoco 5

- Standard multivariate methods such as [partial] PCA/RDA/CA/DCA/CCA

But also:

- Response curves (regression by GLM/GAMs with one predictor)
 - Contour plots (GLM/GAM with two predictors)
 - Distance-based methods incl. nonmetric multidimensional scaling (NMDS)
 - Variation partitioning
 - Principal response curves (PRC)
 - Generalized linear models (GLM) with permutation tests
 - Double-constrained analyses (dc-CA and dc-PCA)
- and more...

Nonlinear response curves via GLM or GAM

Expected number of 12 spider species plotted against a synthetic explanatory variable

Fitted Generalized additive models

Predictors
 Distribution
 Link function

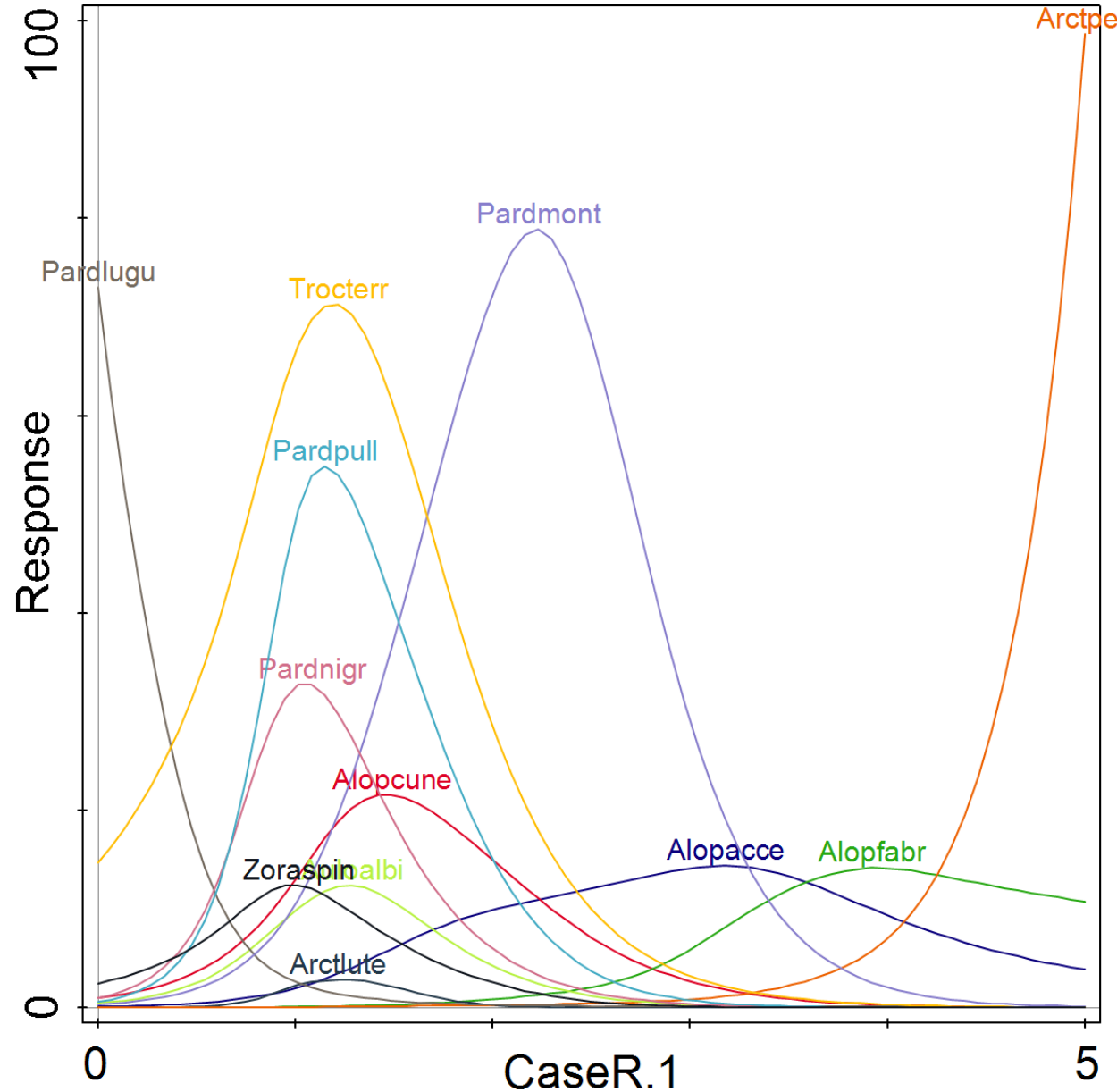
GAM fitted for 12 response variables:

Response	T...	R2[%]	F	p
Alopacce	s3	63.7	53.0	<0.0000
Alopcune	s3	52.2	35.7	<0.0000
Alopfabr	s3	84.2	130.1	<0.0000

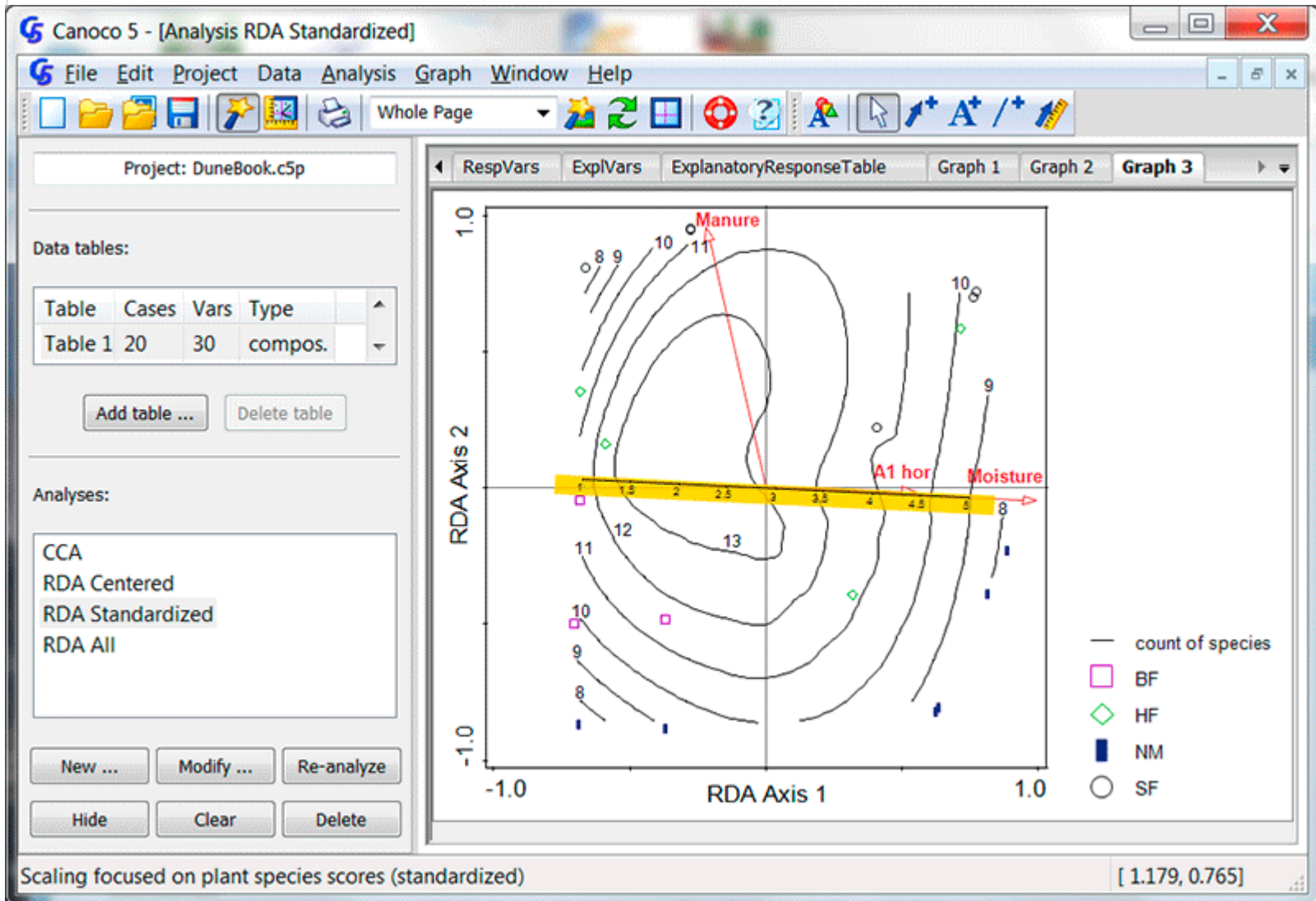
OK

Help

Copy



GAMs or GLMs with two predictors



Distance-based methods eg. NMDS

- E.g. from intercity train-time to a map of cities
- PCO/NMDS/db-RDA/Procrustes analysis

Analysis Setup Wizard: NMDS Options (1) ✕

Setup Non-metric MultiDimensional Scaling (NMDS)

Input Data Table

Table 'Plants' contains:

data for calculating meadow distances using this distance measure: imported matrix of (dis)similarities and the actual values are:

Bray-Curtis distance distances

Export distances into TSV file: Browse

NMDS Options


NMDS solution based on axes

Optimize solution by restarting from perturbations of the initial, PCO-based configuration

Stress formula: type 2 type 1

Treatment of ties in distances: primary secondary

Project plant species as supplementary data



Variation partitioning

Which part of variation is due to

(a) Environment

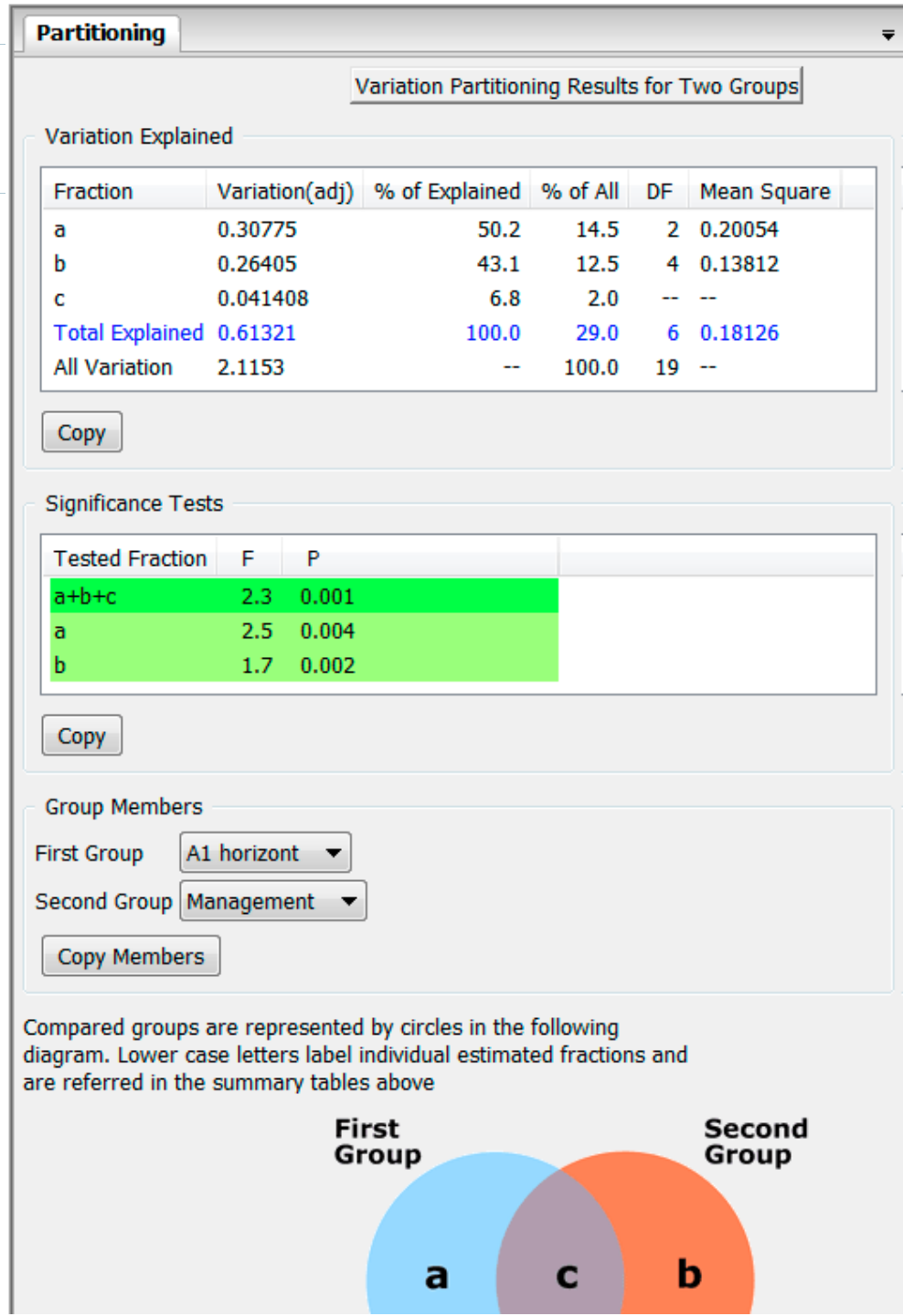
and which to

(b) Management

and which part is

(c) shared?

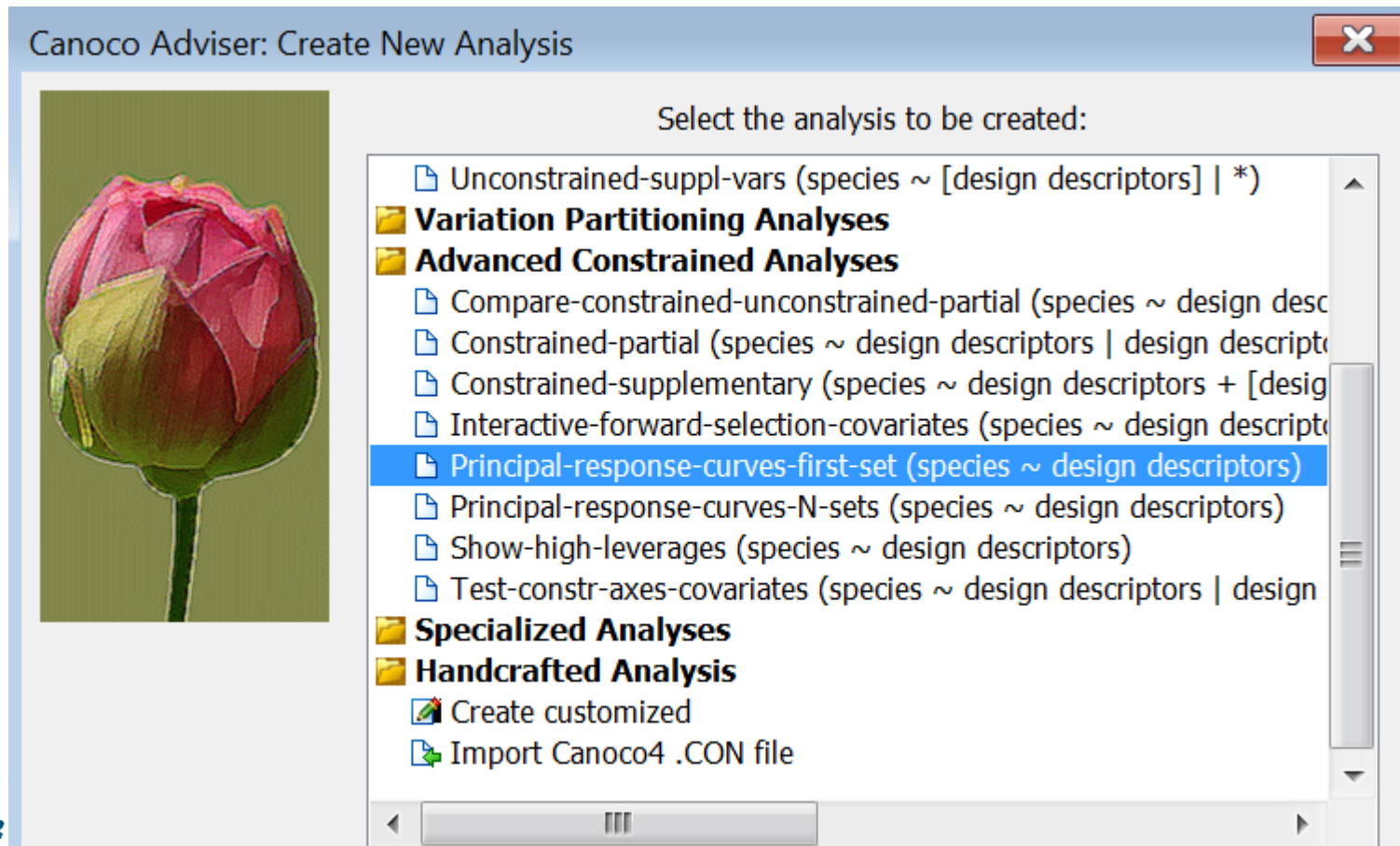
two or three groups of variables



Principal response curves (PRC)

Method to show main effect + interaction


“How does the effect of a pesticide change over time?”



Principal response curves (PRC)(2)

■ Specify Time and Treatment factors

Analysis Setup Wizard: Principal Response Curves (PRC)



Principal response curves test and display treatment effects that change across time. Specify here the two factors coding temporal and treatment effects, respectively.
Further, you should specify quantitative time values corresponding to individual levels of the temporal factor.

Temporal Factor: Dose, Week

Treatment Factor: Dose, Week

■ Specify time values for horizontal axis (default often good)

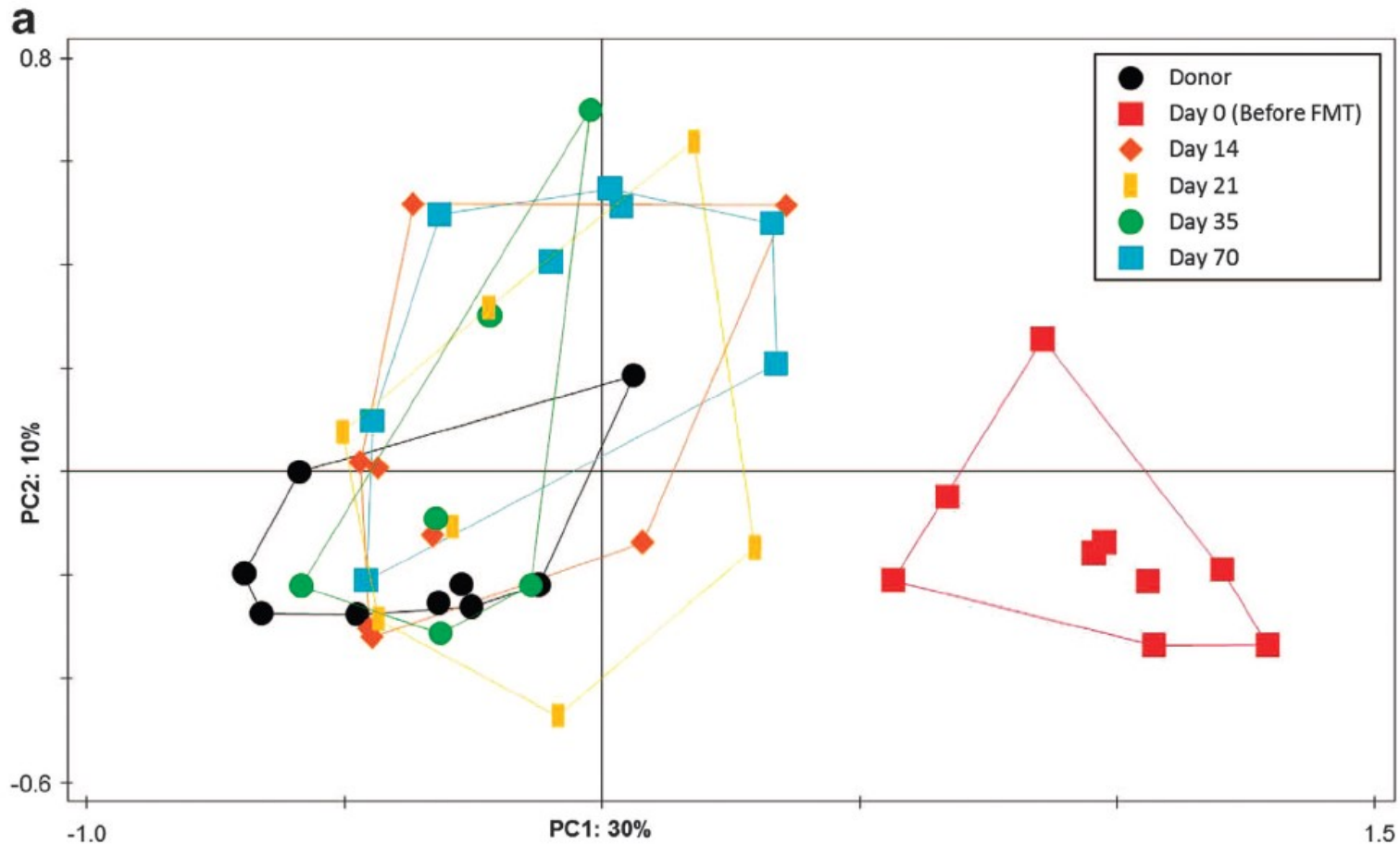
Temporal Factor Levels Translation

Specify numeric time value for each factor level:

Level name	Time va
Wk-4	-4
Wk-1	-1
Wk0.1	0.1
Wk1	1

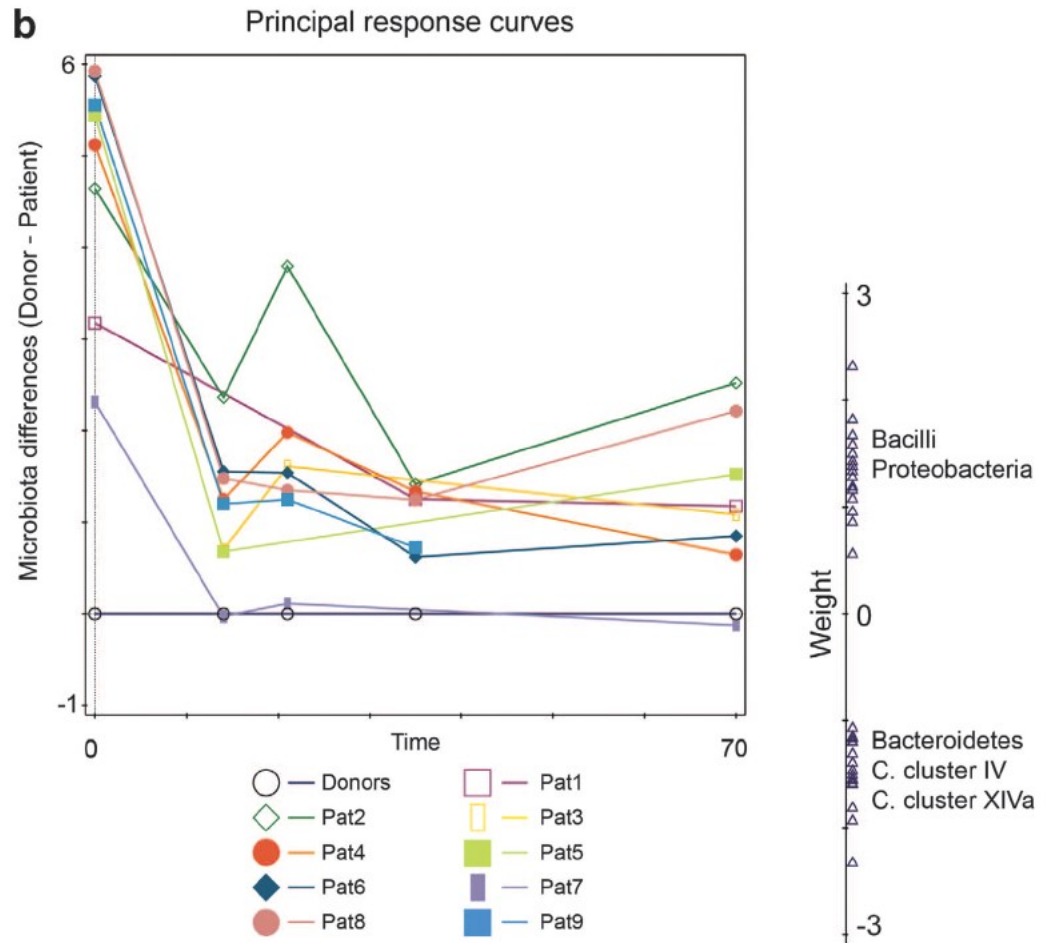
Canoco in faecal transplant study (1)

Development of microbiota in patients: PCA



Canoco in faecal transplant study (2)

Development of microbiota in patients



Co-correspondence analysis

- How are two compositional data tables related?

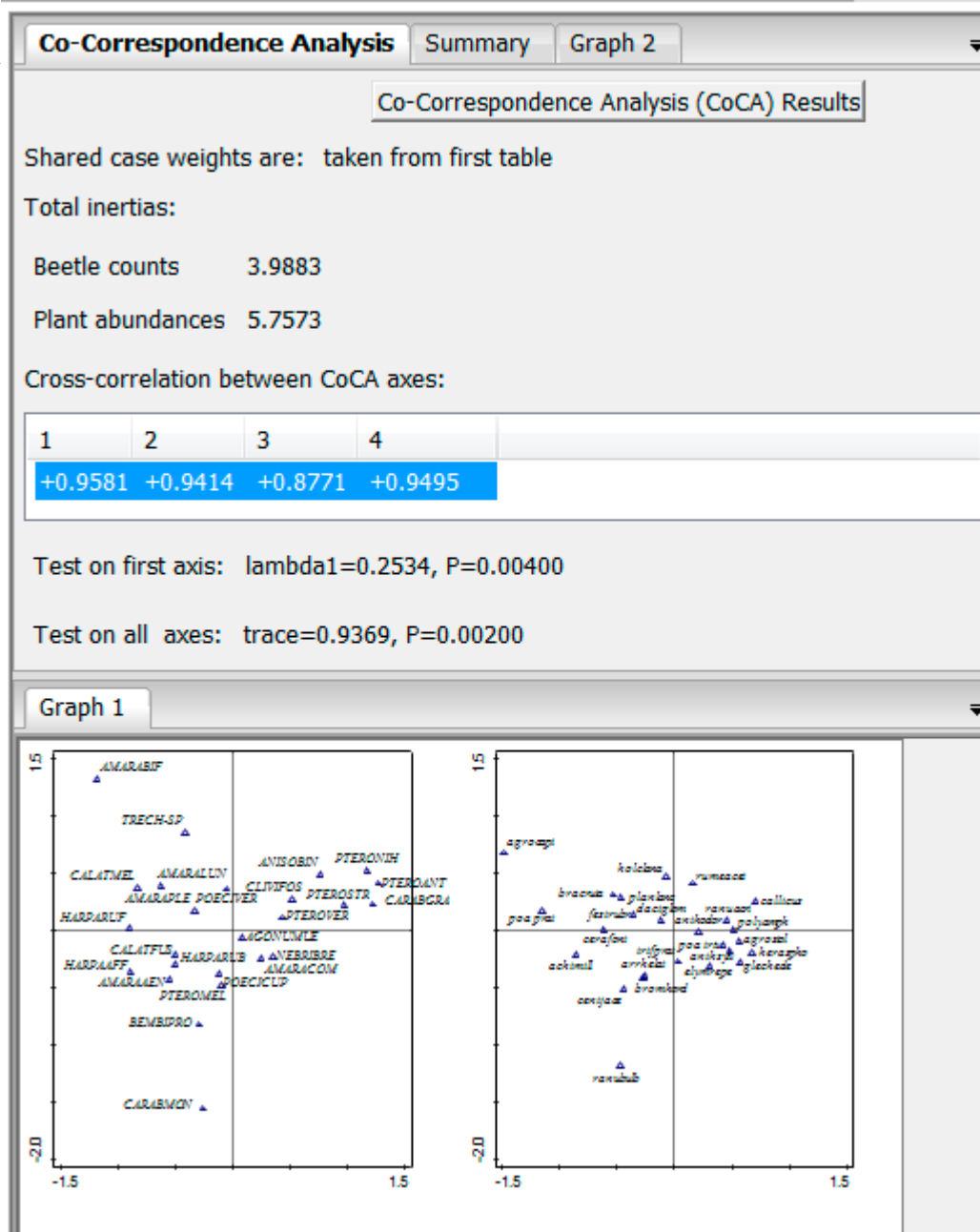
e.g.

plant and beetle communities

(Schaffers et al. 2008)

auto- and heterotrophic microbial assemblages

(Alric et al. 2018, Mol Ecol Res)



Trait-based analyses and phylogenetic relations

- Trait averages
- Functional diversity
- Double-constrained correspondence analysis (dc-CA)
- Phylogenetic corrections

Species	Environment	Traits	Trait Averages	Functional Diversity			
			C1	C2	C3	C4	C5
	Labels	Polycarpic	CNratio	seed.mass.log	SLA	height	
R1	ACHIMILL	polycarp		12.94	-0.876	19.63	2
R2	AGROCAPI	polycarp		17.421	-1.444	29.54	21
R3	ANTHODOR	polycarp		13.778	-0.678	29.97	14
R4	BRIZMEDI	polycarp		33.69	-0.578	25.93	20
R5	BROMHORD	monocarp		16.183	0.305	26.19	12
R6	CAPSBURS	monocarp					15
R7	CAREFLAC	polycarp					2
R8	CAREHIRT	polycarp					15
R9	CARENIGR	polycarp					15
R10	CENTJACE	polycarp					56
R11	CERAAARVE	polycarp					1
R12	CERAGLOM	monocarp					3
R13	CIRSARVE	polycarp					36
R14	CYNOCRIS	polycarp					16
R15	DAUCCARO	polycarp					
R16	DESCCESP.CE	polycarp					
R17	EQUIPALU	polycarp					
R18	FESTOVIN	polycarp					
R19	FESTPRAT	polycarp					
R20	FESTRUBR	polycarp		23.679	-0.235	18.6	
R21	GALIMOLL	polycarp		17.856	-0.372	21.11	4
R22	GALIULIG	polycarp		27.043	-0.772	29.63	

Import Phylogenetic Tree ✕

Name of imported file:
 Browse...

Default branch length:

Terminal items of the tree correspond to:

Item labels in the tree correspond better to:
 short labels full labels

Generalized linear models (GLM)

Via

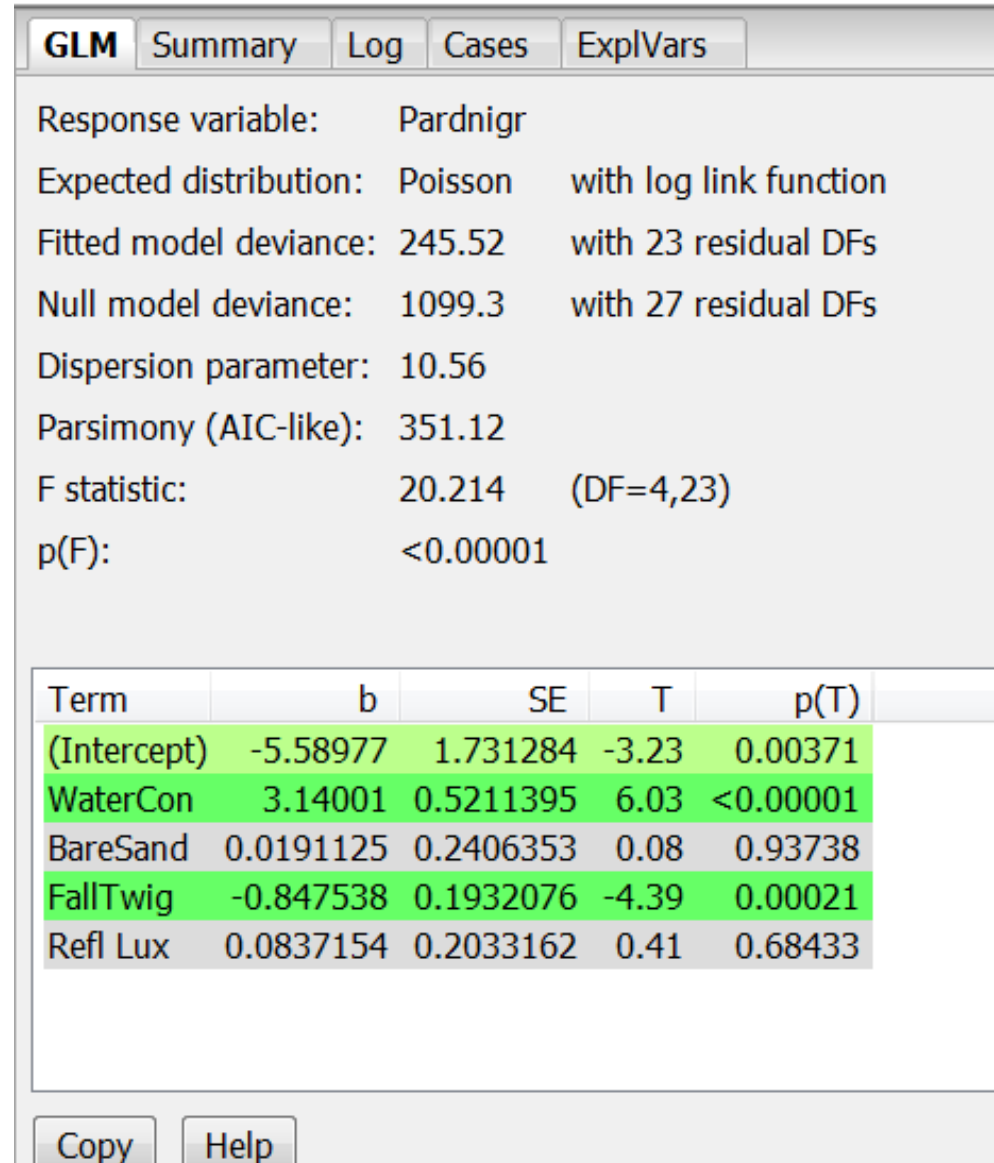
- GLM template for ≥ 1 predictors
- Graph| Attribute plots

1 predictor:

- Multiple response curves in single graph

2 predictors:

- Contour plot

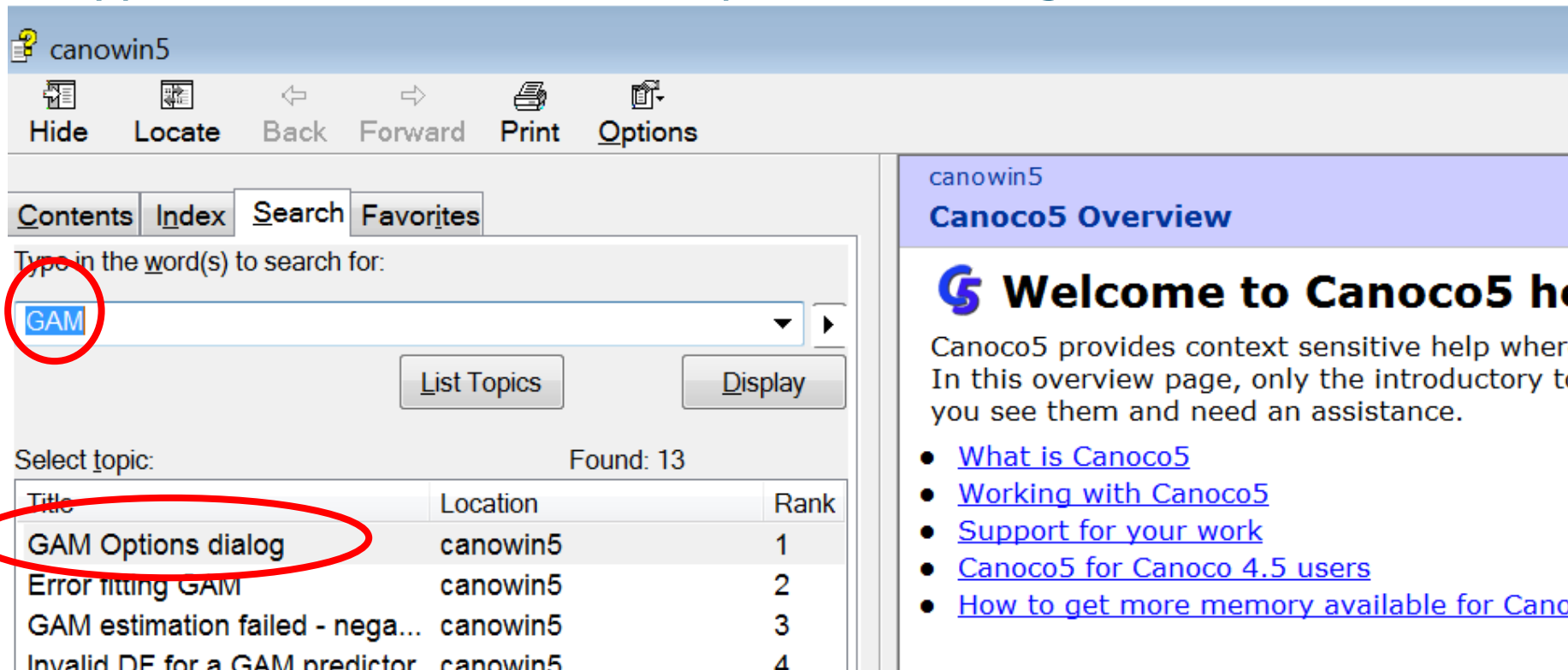


The screenshot shows the SPSS GLM Summary dialog box. The response variable is 'Pardnigr', and the expected distribution is Poisson with a log link function. The fitted model deviance is 245.52 with 23 residual degrees of freedom, while the null model deviance is 1099.3 with 27 residual degrees of freedom. The dispersion parameter is 10.56, and the parsimony (AIC-like) is 351.12. The F statistic is 20.214 (DF=4,23) with a p-value of <0.00001.

Term	b	SE	T	p(T)
(Intercept)	-5.58977	1.731284	-3.23	0.00371
WaterCon	3.14001	0.5211395	6.03	<0.00001
BareSand	0.0191125	0.2406353	0.08	0.93738
FallTwig	-0.847538	0.1932076	-4.39	0.00021
Refl Lux	0.0837154	0.2033162	0.41	0.68433

Find out how to get a method, eg. GAM (1)

- Help|Help contents (Alt-h-h) opens the help system
- Type GAM in search field, press Enter, gives



The screenshot shows the Canoco5 help system interface. The search field contains the text "GAM". Below the search field, there are buttons for "List Topics" and "Display". The search results are displayed in a table with columns for "Title", "Location", and "Rank". The first result, "GAM Options dialog", is circled in red. The right sidebar shows the "Canoco5 Overview" page with a welcome message and a list of links.

canowin5

Hide Locate Back Forward Print Options

Contents Index Search Favorites

Type in the word(s) to search for:

GAM

List Topics Display

Select topic: Found: 13

Title	Location	Rank
GAM Options dialog	canowin5	1
Error fitting GAM	canowin5	2
GAM estimation failed - nega...	canowin5	3
Invalid DF for a GAM predictor	canowin5	4

canowin5

Canoco5 Overview

Welcome to Canoco5 h

Canoco5 provides context sensitive help when...
In this overview page, only the introductory t...
you see them and need an assistance.

- [What is Canoco5](#)
- [Working with Canoco5](#)
- [Support for your work](#)
- [Canoco5 for Canoco 4.5 users](#)
- [How to get more memory available for Canoco5](#)

Find out how to get a method, eg. GAM (2)

Look in manual or use on-line help as follows:

- Help|Help contents (Alt-h-h) opens the help system
- Type GAM in search field, press Enter
- Click *GAM options dialog*
- Scroll down in the help page to find

Getting Here: You
or when specifying:

where it says:

Use one of the commands in *Graph / Attribute plots* submenu (use the *Model Options* button)

Type: response curves → topic Response curves plot →
Getting Here: use *Graph / Attribute plots / <Col-
term> response curves*

Options for ordination graphs

- In Canoco, graphs belong to an analysis
- Options for graphs can therefore be found under Analysis
- Click: Analysis|Plot creation options..

The screenshot shows the 'Plot Settings' dialog box with the following sections and options:

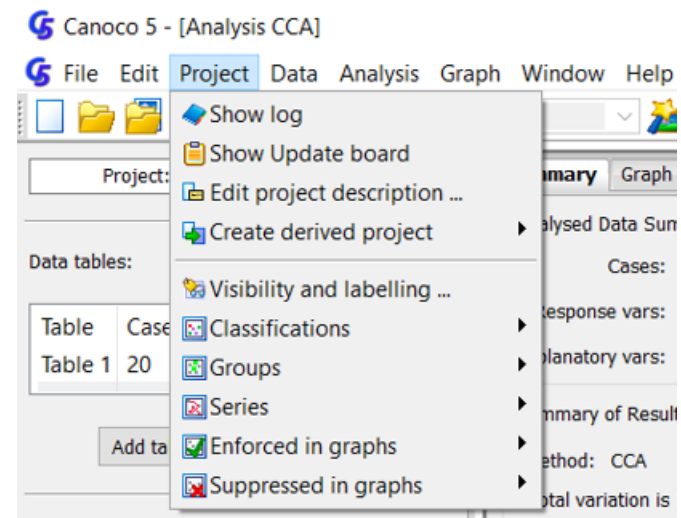
- General** (selected in the left sidebar)
- Plant species Selection**
- Sample Selection**
- Predictor Selection**
- Axes selection**
 - Horizontal: Plot axes: 1
 - Vertical: Plot axes: 2
 - Flip axes: Horizontal, Vertical
- Plot envelopes for**
 - samples, plant species
 - environmental variables, suppl. variables
- Scores display**
 - Use CaseR scores for constrained axes
 - Use case-shift plots
 - Show response variables as symbols in linear methods
 - Customize environmental variables
 - Customize suppl. variables
- Supplement response variables in linear methods with: no circle
- Use pies instead of symbols**
 - for samples, slices based on: values, presences
 - for plant species, slices based on: values, presences

Buttons: OK, Cancel, Help

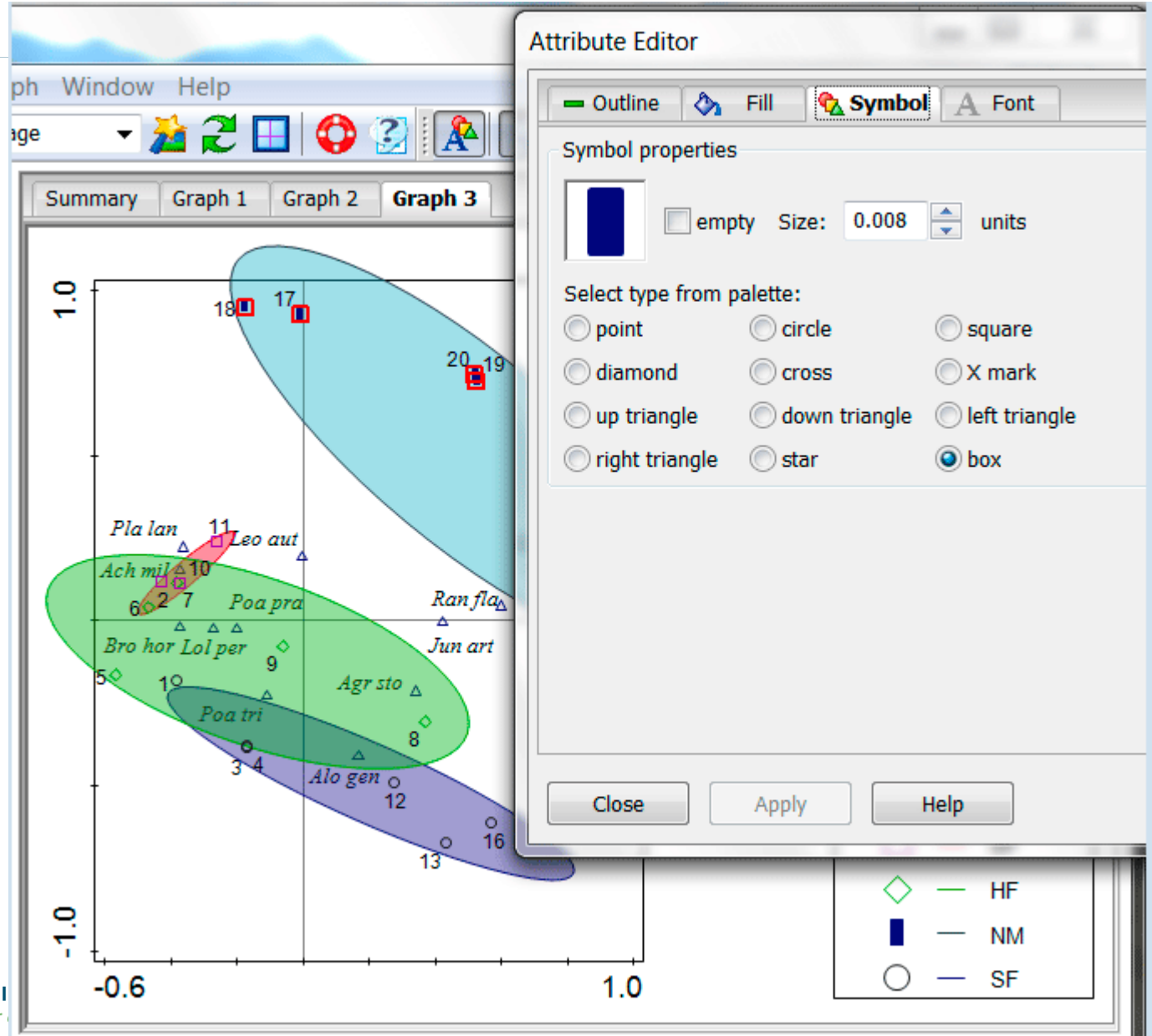
Classification and groups

Click Project on the toolbar

- to create classifications, groups or series¹ of samples and species
 - for use in plotting (e.g. symbols or colours per class)
 - to plot a subset
 - etc.
- See example on next slide



Ellipses and transparent colours

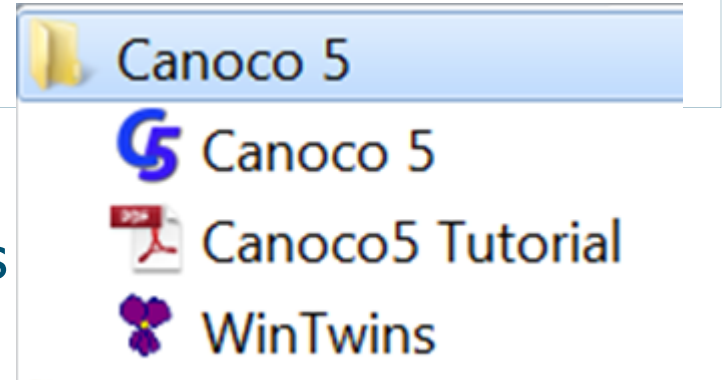


Also available in Canoco 5

- **Predicted** and fitted **response values** for constrained methods, via *Data | Add new table | Predict..*; Alt-d-a-p
- Calibration - **predicted explanatory values**; imputing of missing explanatory values on basis of constrained meth. via *Advanced constrained template*
- Diversity indices, via *Data | Add new table | Statistics*; Alt-d-a-s
- Functional diversity via Alt-d-f
- Indicator values of species for a grouping
- Multiple testing and FDR
- Multi-step analyses and more...

Resources/help

- Canoco 5 Tutorial under Programs
- Canoco 5 manual: ~500 pp
- Support site with Discussion list: www.canoco5.com
- Demo and practical



Thank you!



WAGENINGENUR
For quality of life