Tree Diversity Analysis:
Application to sentinel landscape data

Introduction to BiodiversityR

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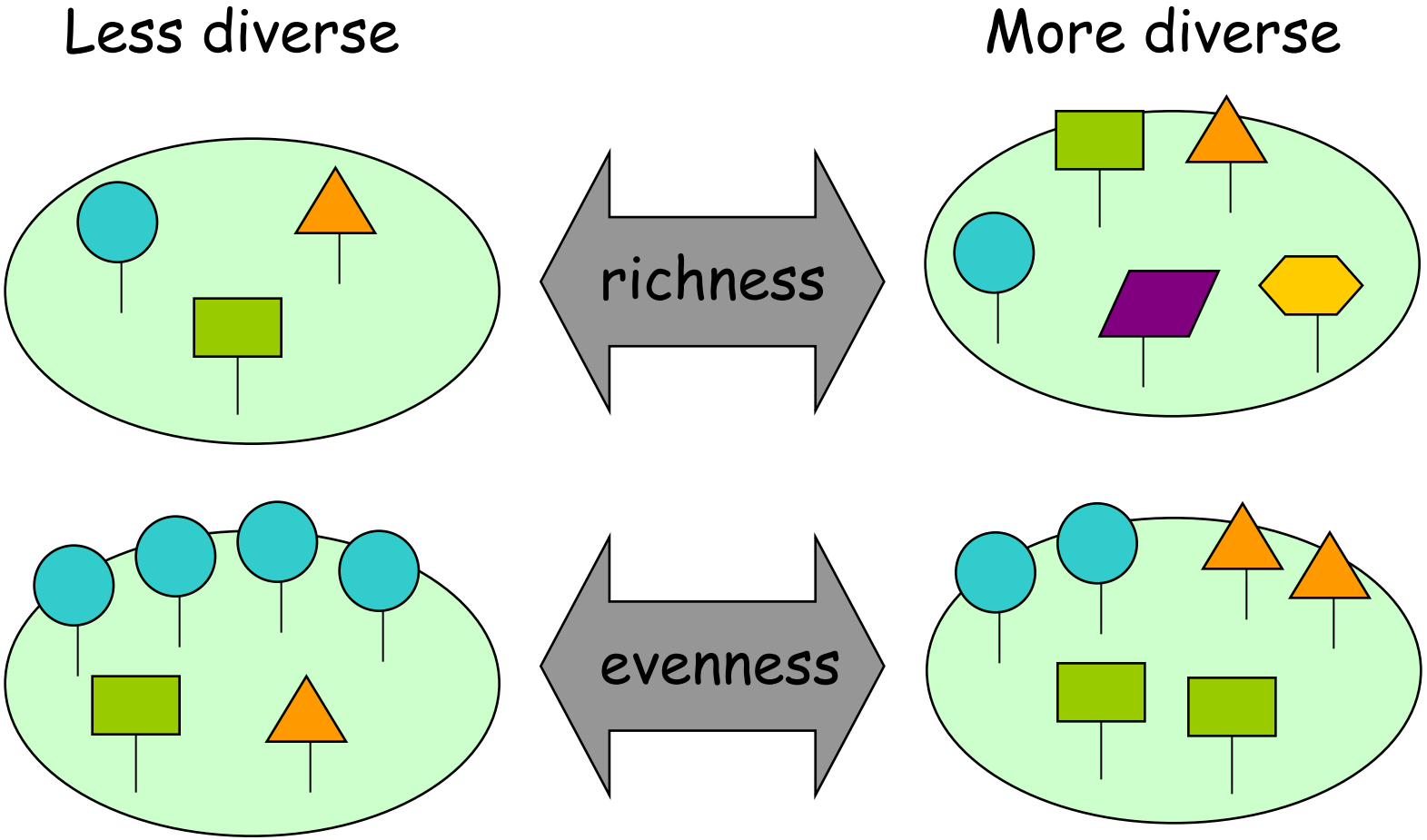
How to measure diversity?

- Richness: species number
- Diversity: richness and evenness
- Sample size effects (hierarchical structure)
- Differences in species composition: ordination and cluster analysis

Diversity: richness and evenness



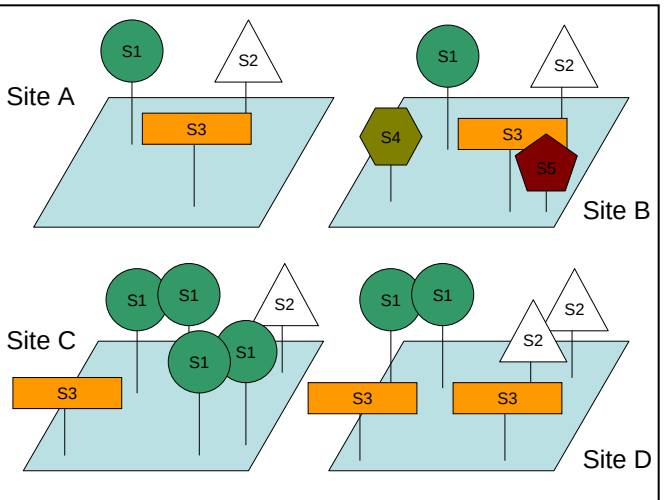
Rényi diversity profiles

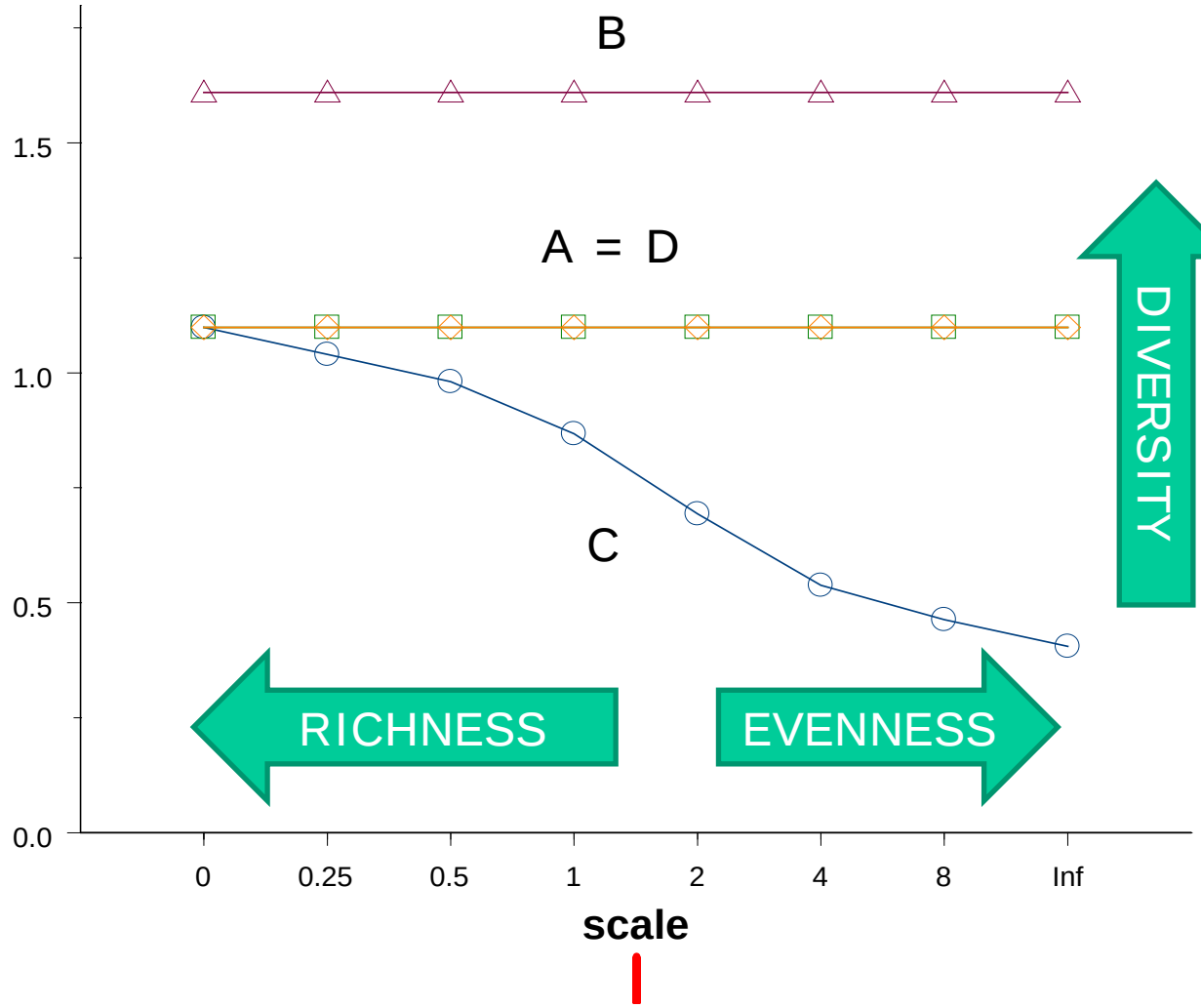
- One of several methods for diversity ordering
- Considers richness and evenness
- Based on proportional abundance for each species

$$H_\alpha = \frac{\ln(\sum_{i=1}^{S} p_i^\alpha)}{1-\alpha}$$

Rényi diversity profiles

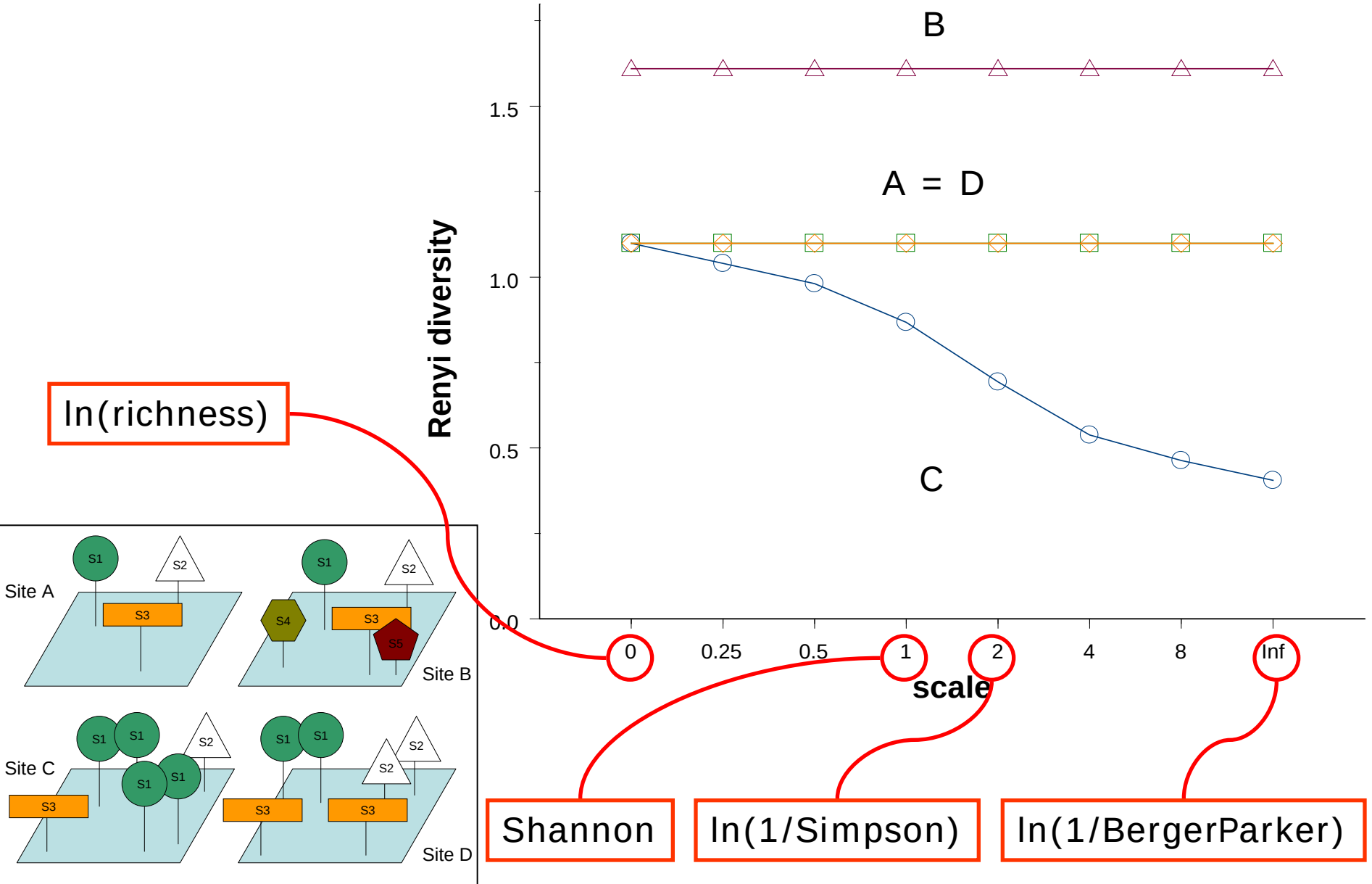
Diversity profile ranks communities according to differences in diversity



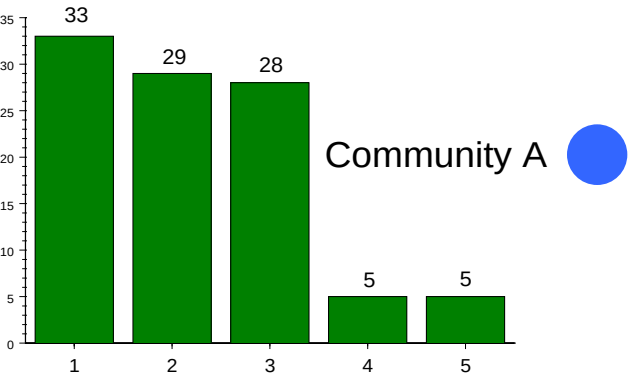


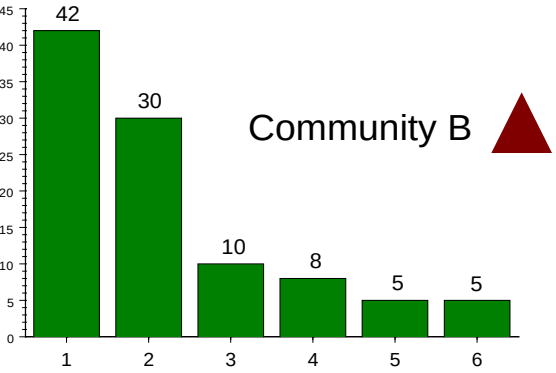
Scale parameter changes influence of richness and evenness on diversity measurement

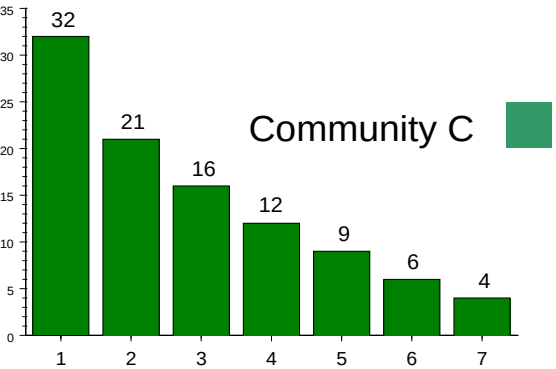
Rényi diversity profiles

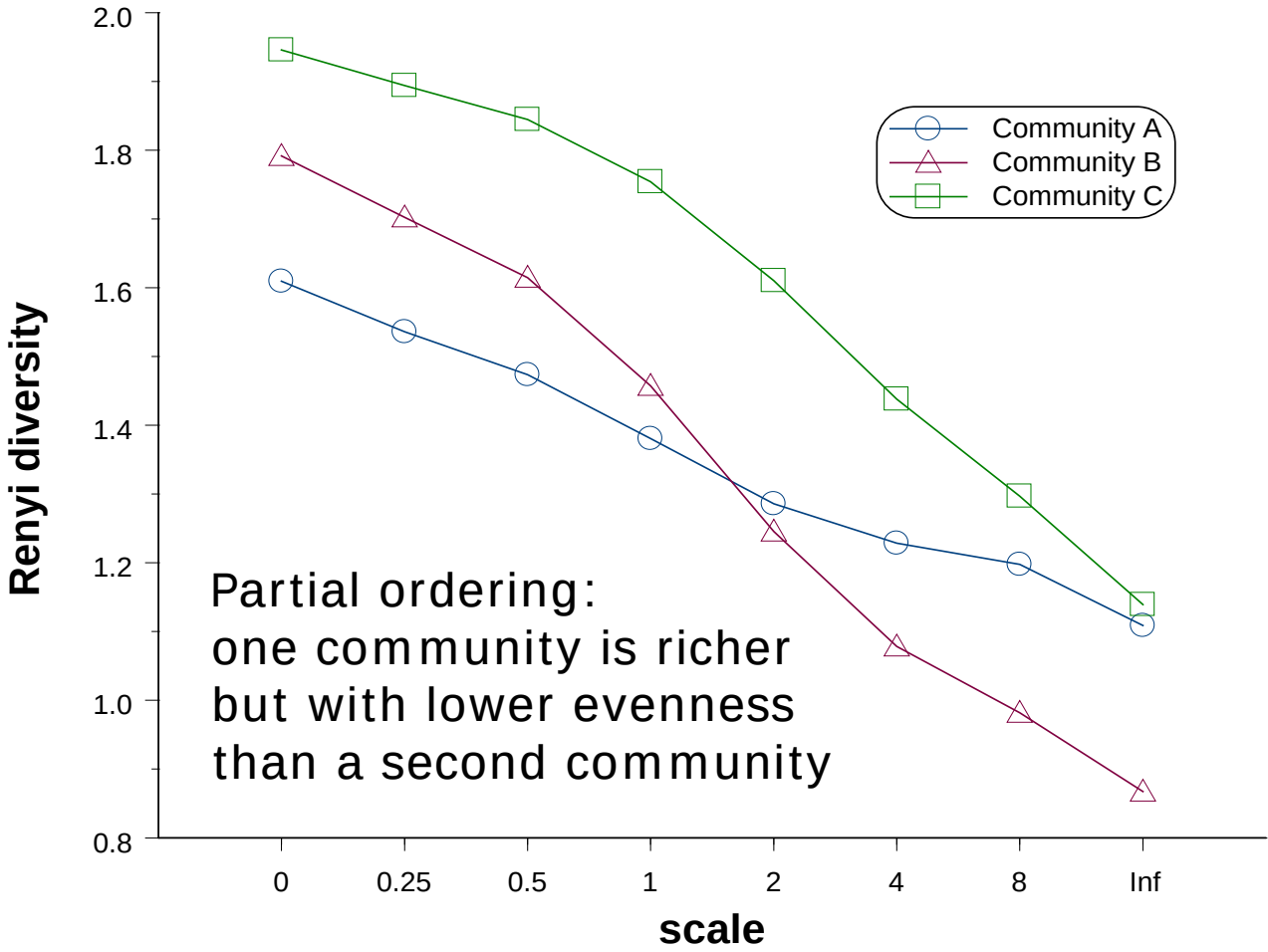


Rényi diversity profiles

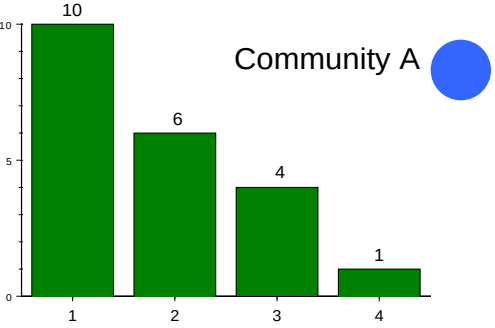


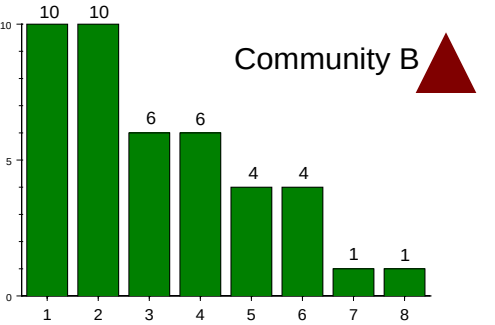


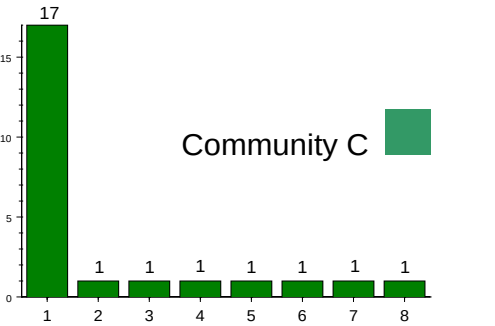


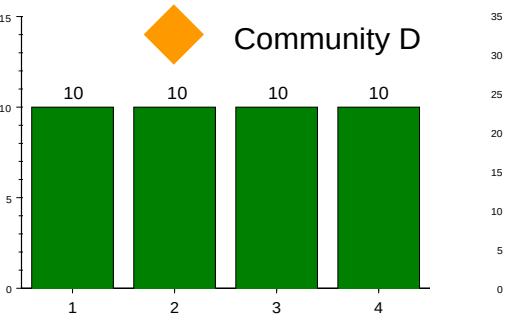


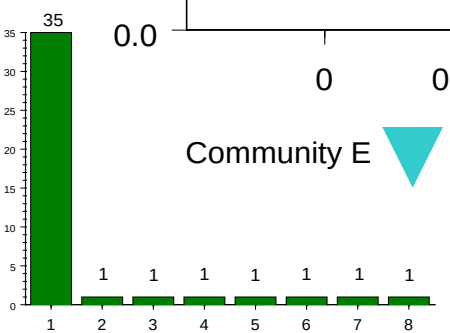
Rényi diversity profiles

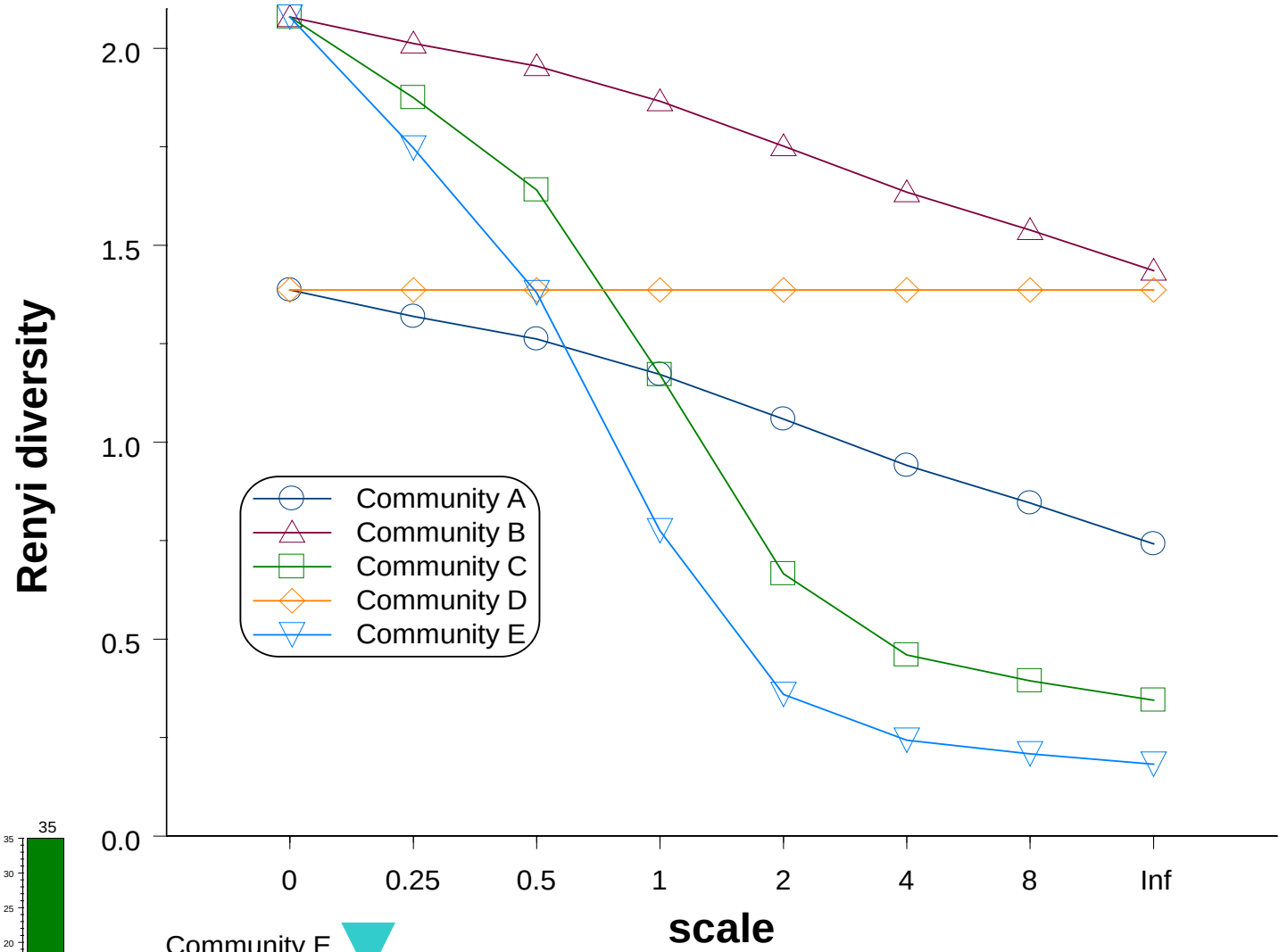


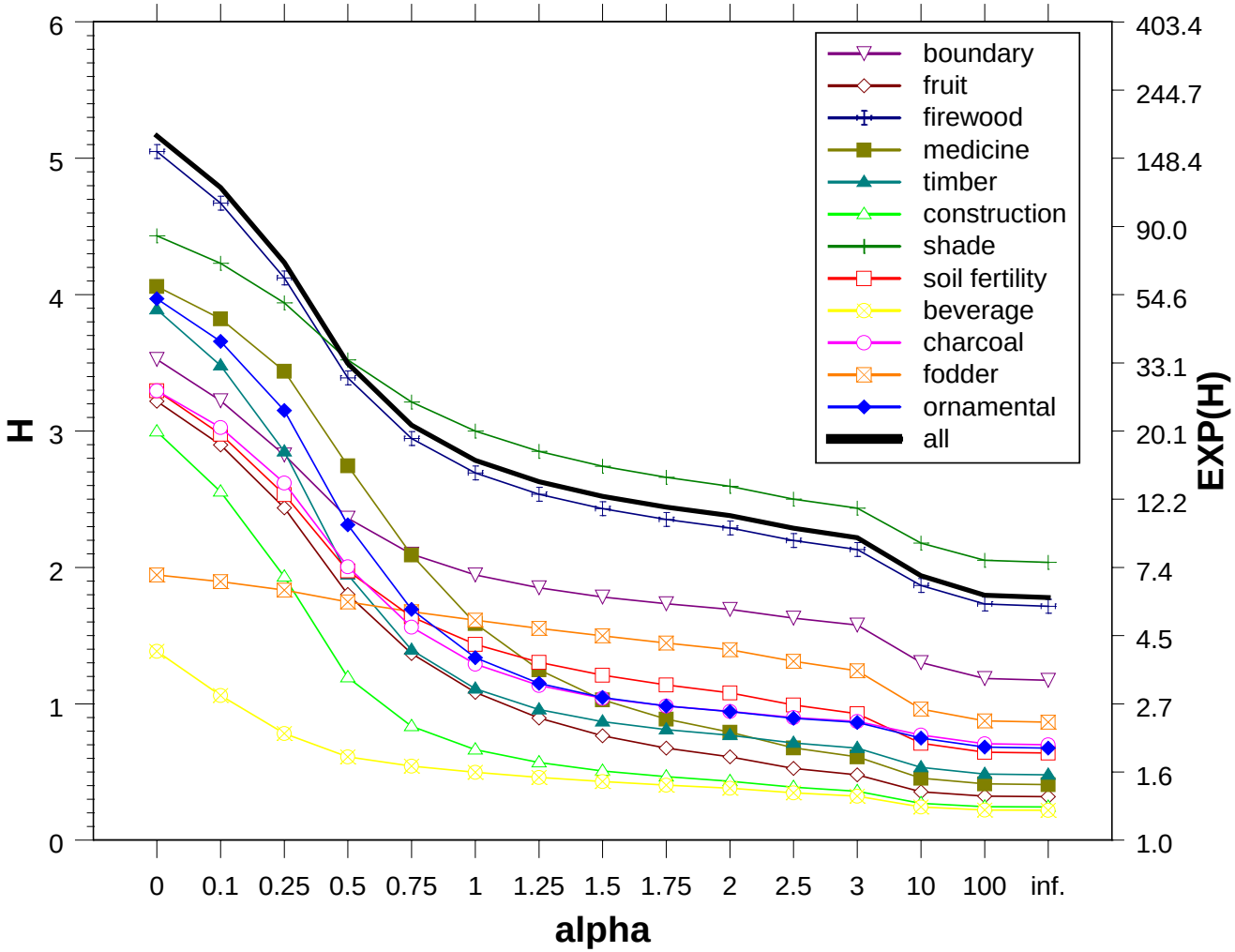




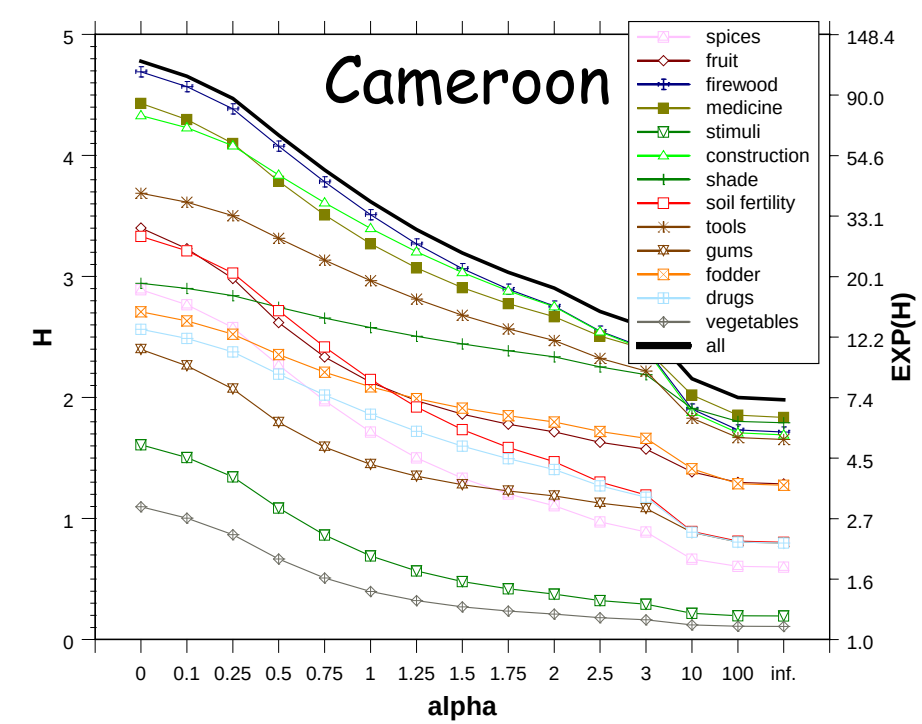








Kindt R, Van Damme P, Simons AJ. 2006.
Tree diversity in western Kenya: using profiles to characterise richness and evenness.
Biodiversity and Conservation 15: 1253-1270.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fruit
firewood
medicine
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construction
shade
soil fertility
tools
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fodder
drugs
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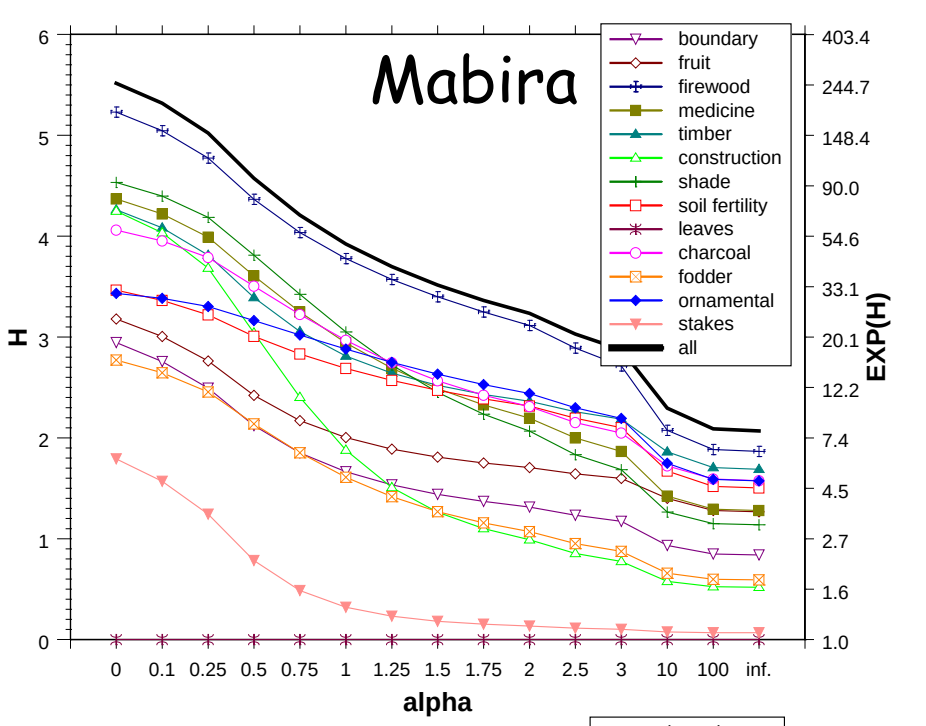
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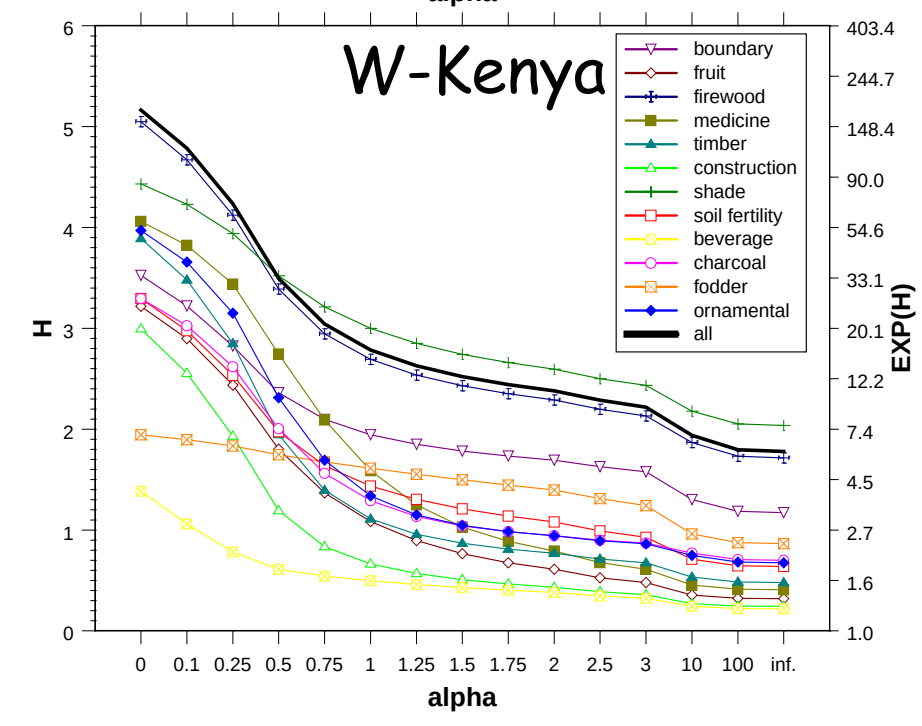
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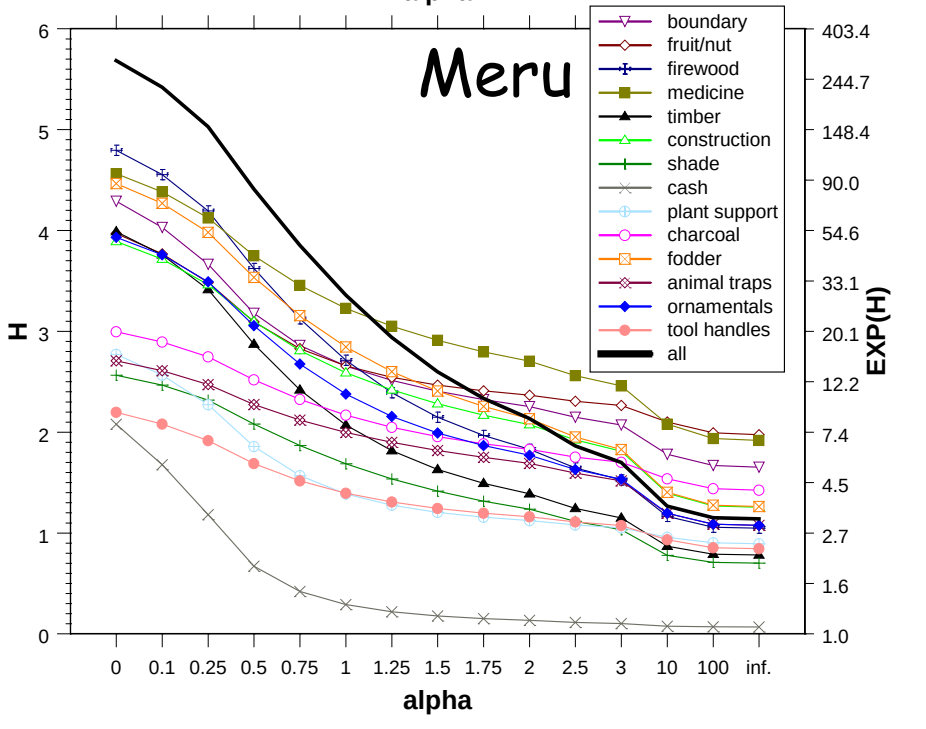
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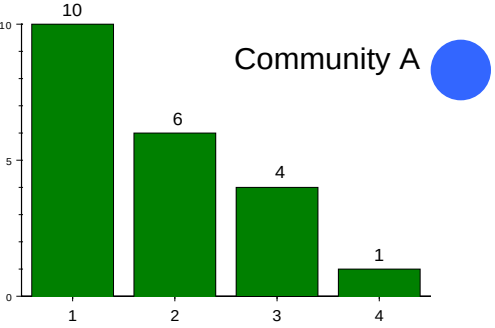
fruit/nut
firewood
medicine
timber
construction
shade
cash
plant support
charcoal
fodder
animal traps
ornamentals
tool handles
all
H
EXP(H)
alpha
0 0.1 0.25 0.5 0.75 1 1.25 1.5 1.75 2 2.5 3 10 100 inf.
0 1 2 3 4 5 6
1.0 1.6 2.7 4.5 7.4 12.2 20.1 33.1 54.6 90.0 148.4 244.7 403.4

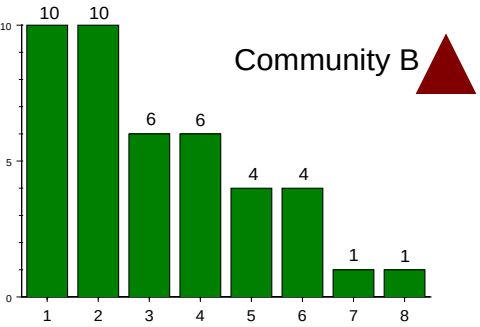
Rényi evenness profiles

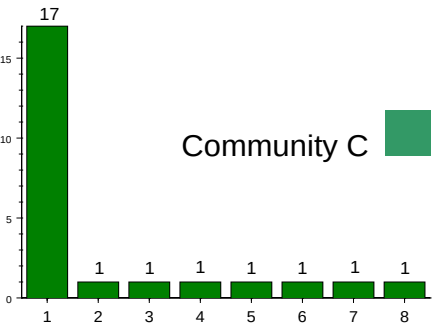
- Based on shape of diversity profiles: when richness is equal then differences in diversity reflect differences in evenness
- Expansion of measurement of evenness of Shannon index
- Transforms evenness defined for Hill diversity series

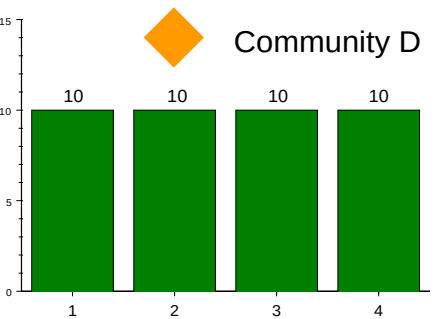
$$\ln E_\alpha = H_\alpha - H_0$$

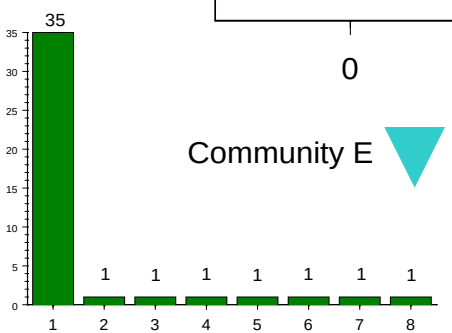
Rényi evenness profiles

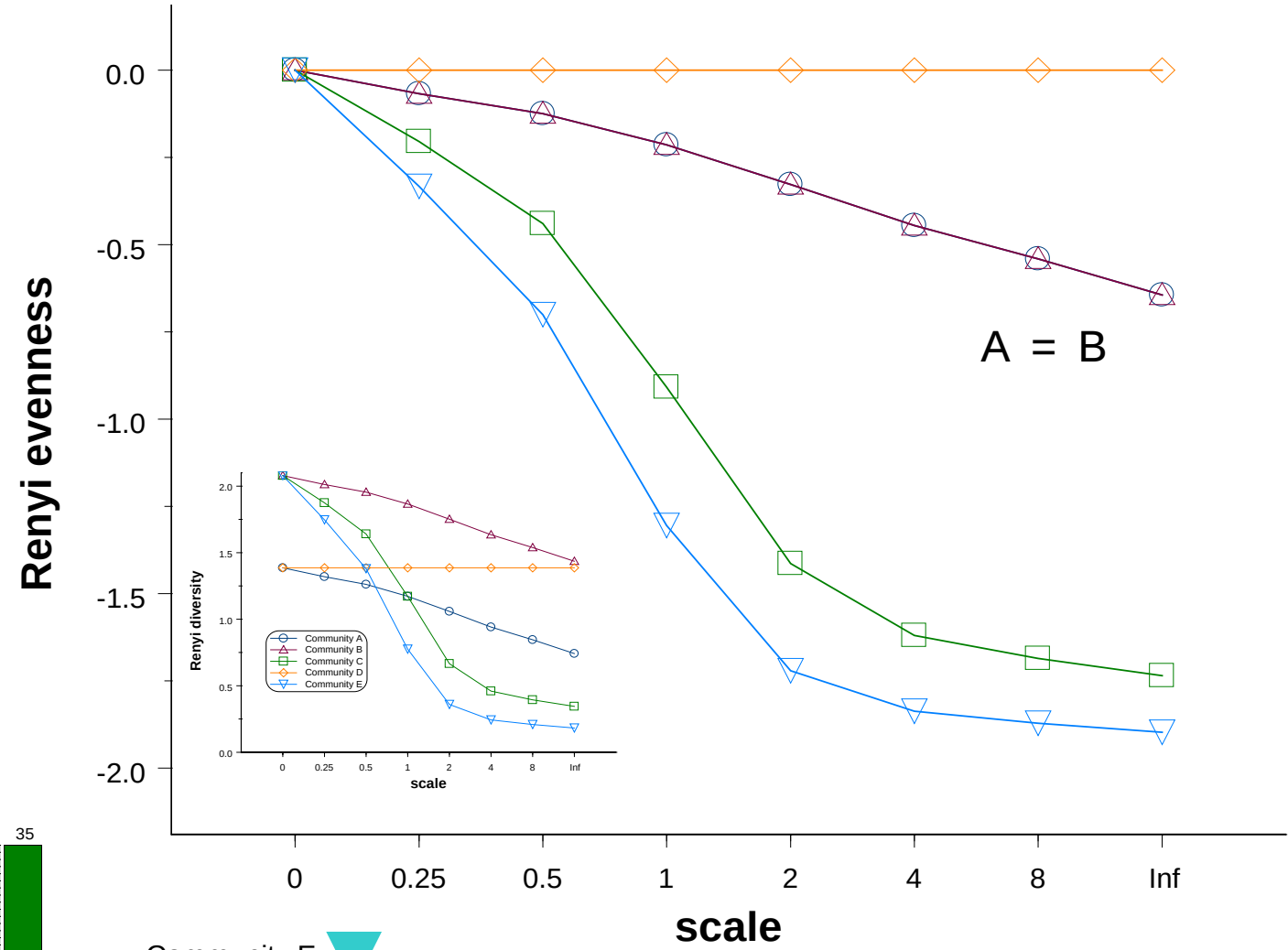




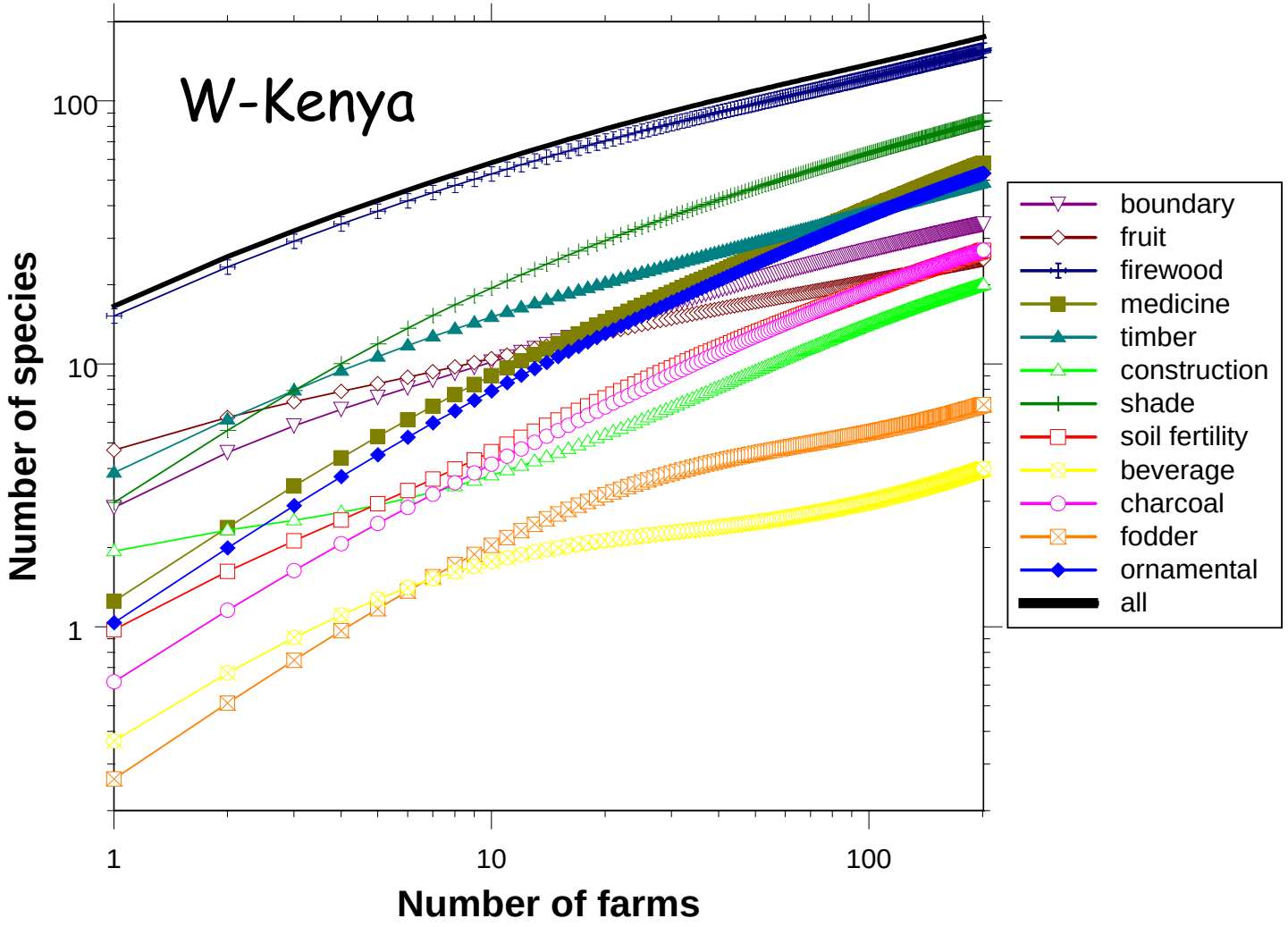






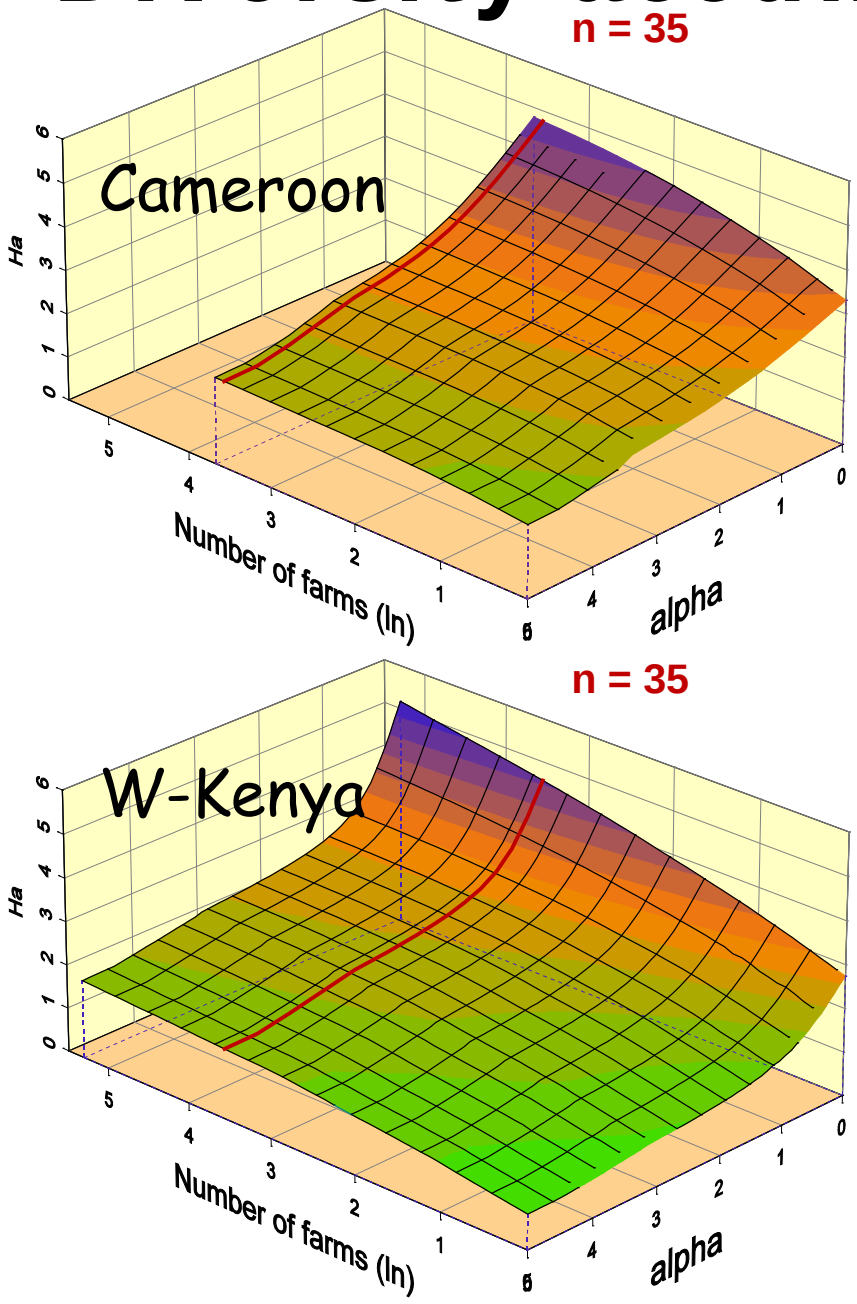


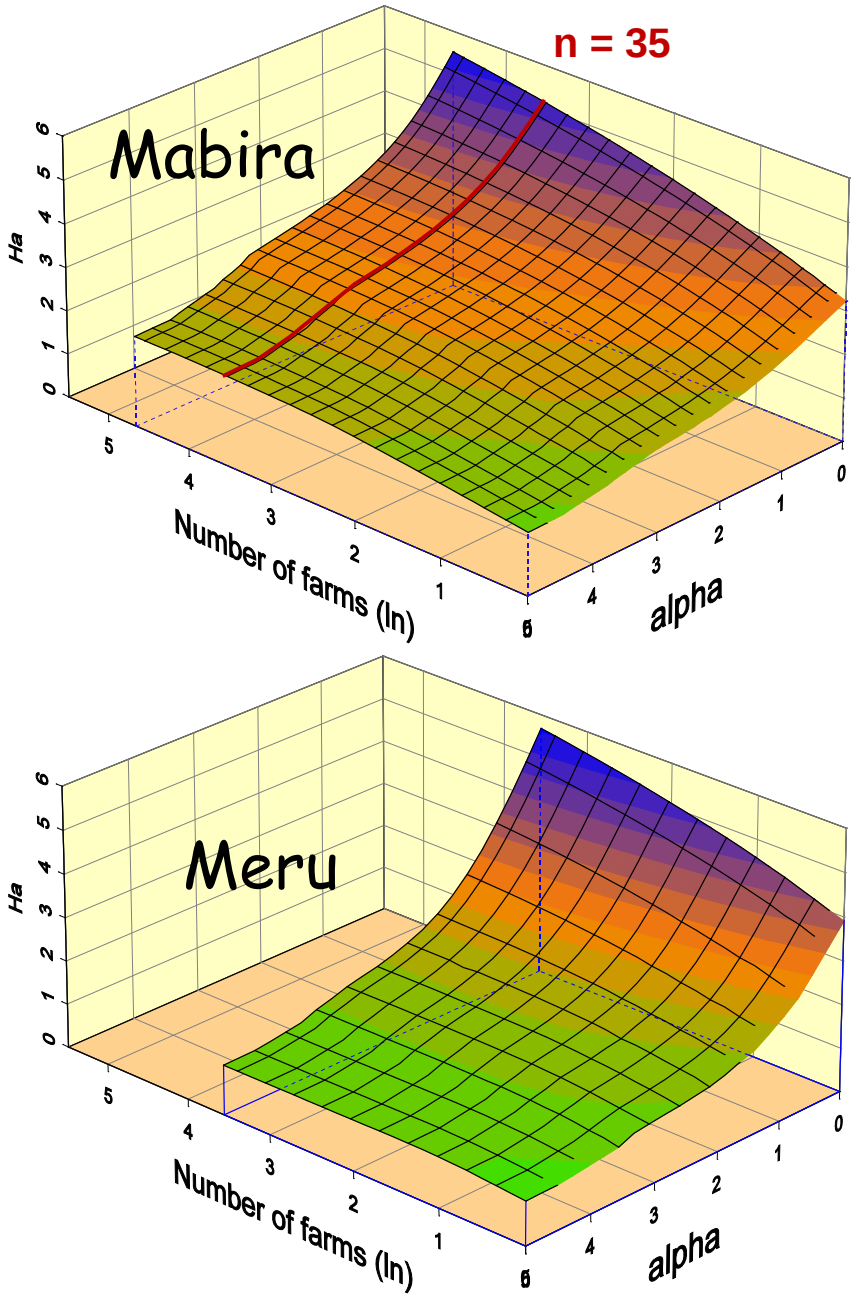
Species accumulation curves



Kindt R, Van Damme P, Simons AJ. 2006. Patterns of Species Richness at Varying Scales in western Kenya: Planning for Agroecosystem Diversification. Biodiversity and Conservation 15: 3235-3249.

Diversity accumulation surfaces



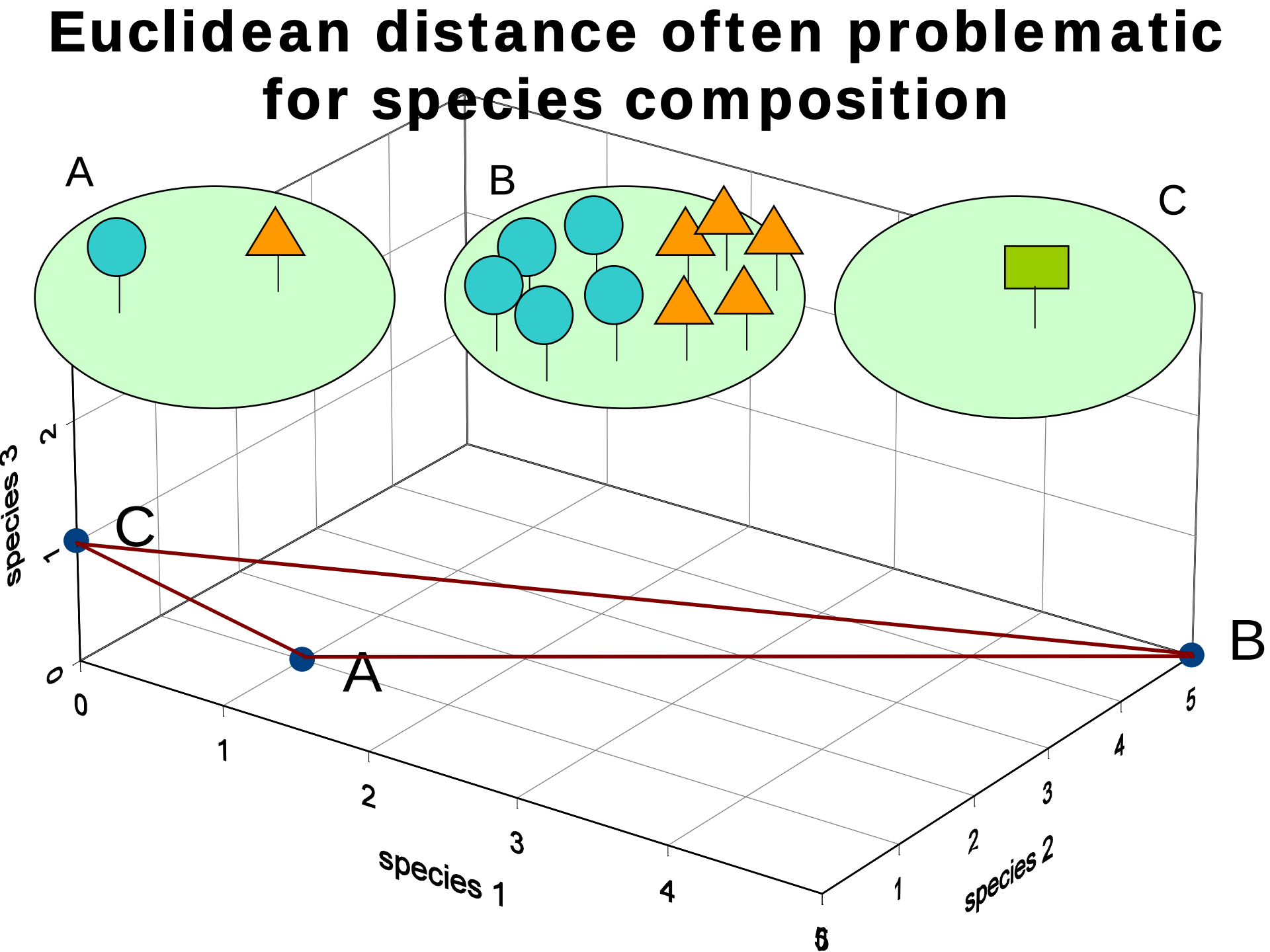


Analysis of differences in species composition

- Diversity only depends on frequencies, not on identities of the species
- Various ecological distance measures for pairwise differences in species composition
- Various ordination and cluster methods to summarize or analyze distances

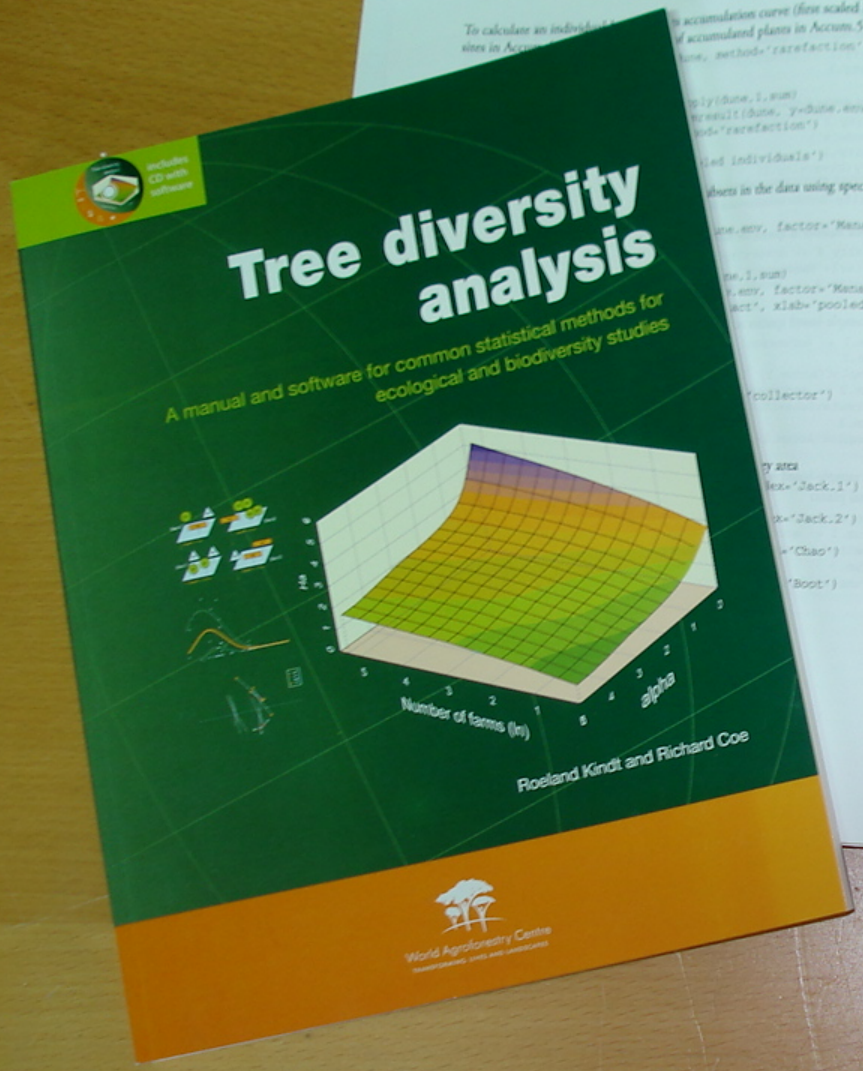
Kindt R, Van Damme P, Simons AJ, Beeckman H. 2006. Planning tree species diversification in Kenya based on differences in tree species composition between farms. I. Study of Tree Uses. Agroforestry Systems 67: 215-228.

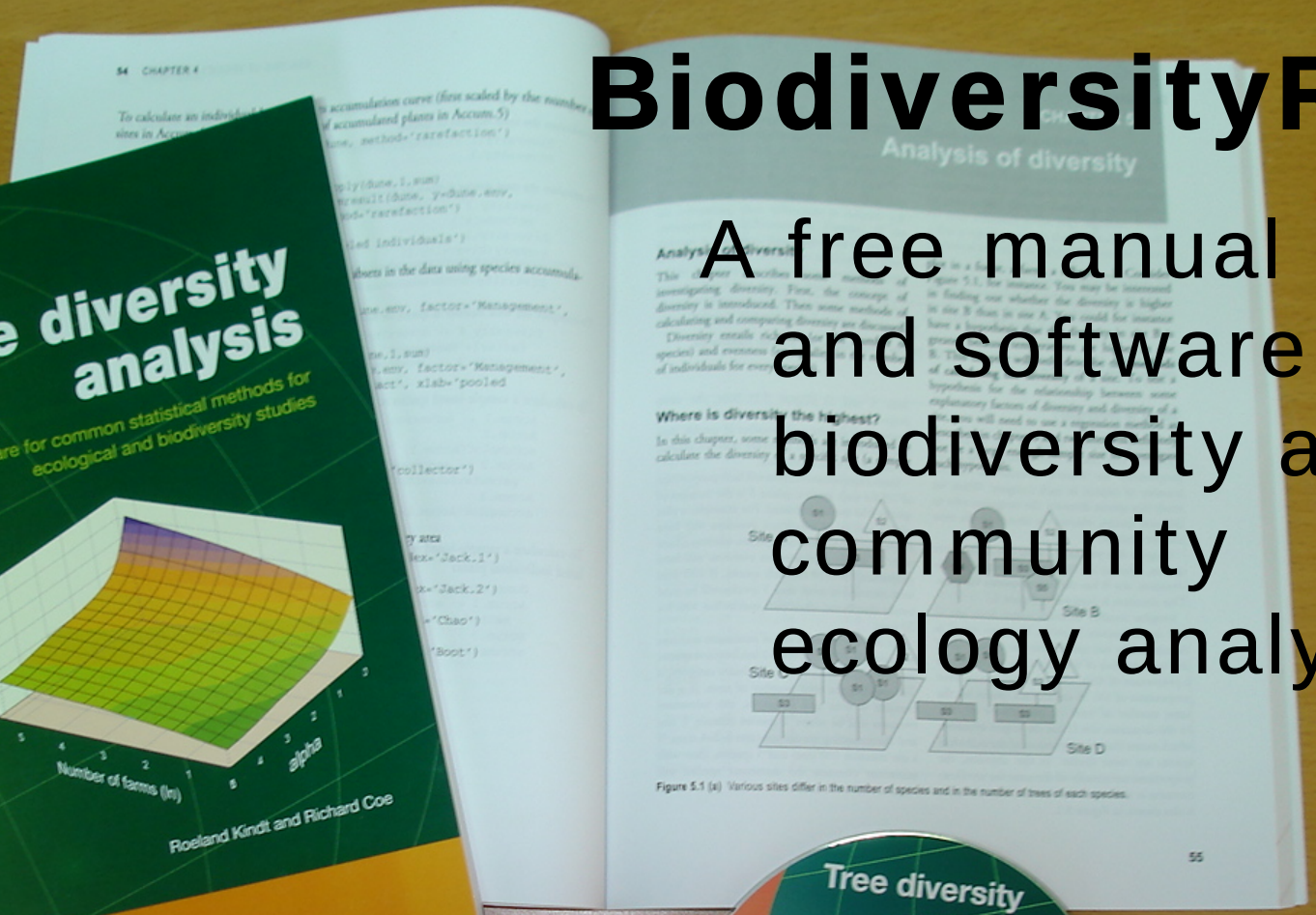
Euclidean distance often problematic for species composition

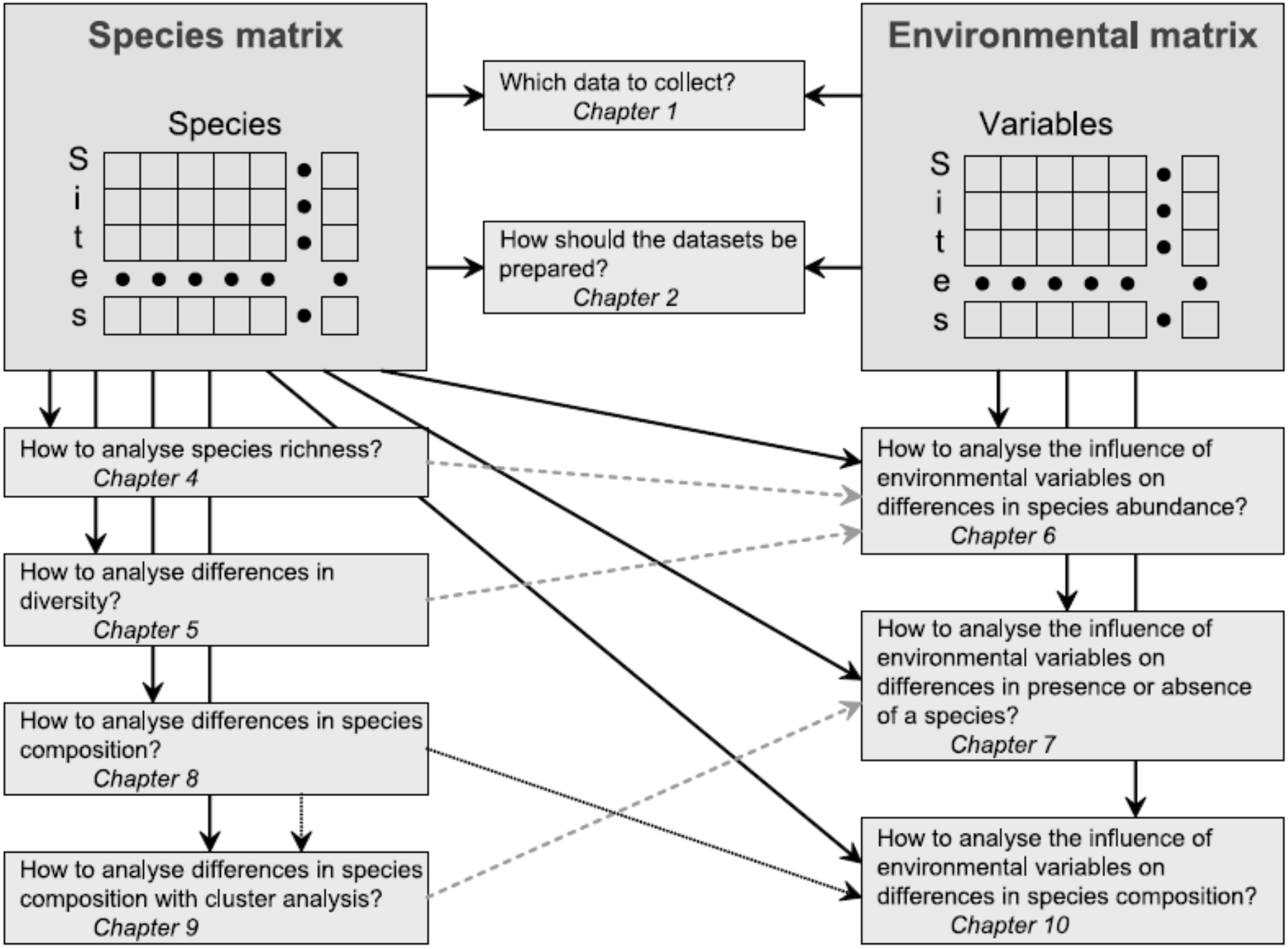


BiodiversityR

A free manual and software for biodiversity and community ecology analysis

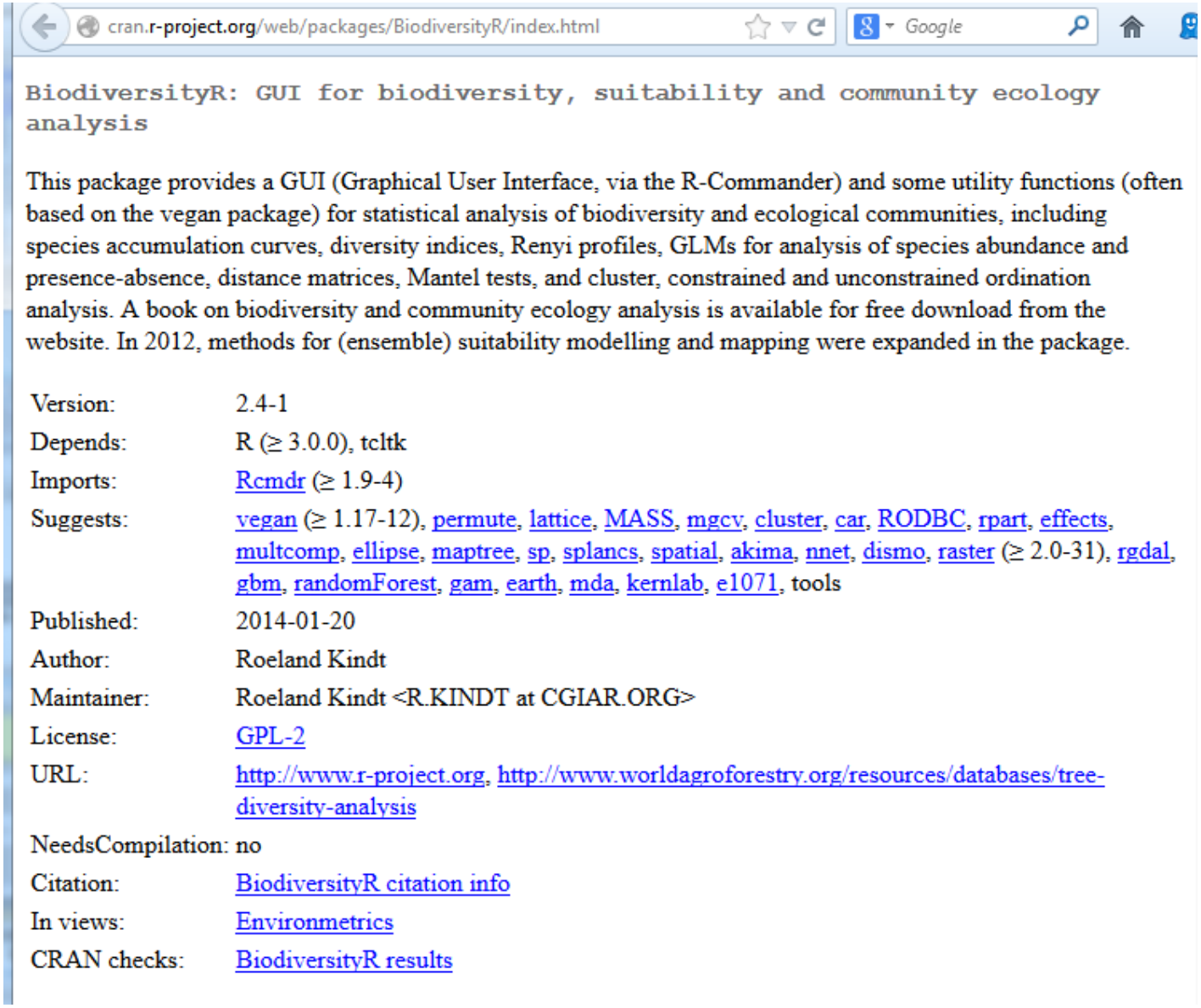





Species matrix
Species
Sites
Environmental matrix
Variables
Sites
Which data to collect?
Chapter 1
How should the datasets be prepared?
Chapter 2
How to analyse species richness?
Chapter 4
How to analyse differences in diversity?
Chapter 5
How to analyse differences in species composition?
Chapter 8
How to analyse differences in species composition with cluster analysis?
Chapter 9
How to analyse the influence of environmental variables on differences in species abundance?
Chapter 6
How to analyse the influence of environmental variables on differences in presence or absence of a species?
Chapter 7
How to analyse the influence of environmental variables on differences in species composition?
Chapter 10

http://cran.r-project.org/web/packages/BiodiversityR/

http://cran.r-project.org/web/packages/vegan/

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Wad Madani
Al Manaqil
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Zefah Game Reserve
Bandingilo National Park
Mundri West
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Finchawa
Omo National Park
Stephanie Wildlife Sanctuary
Adwa
Adigrat
Endasilasie
Mek'ele
Mile Serdo Wildlife Reserve
Yangudi Rassa National Park
Farasan Island Marine Sanctuary
Abu Arish
Jazan
Sana'a
Al Hudaydah
Dhamar
Ash Shihr
Al Mukalla
Ta'izz
Al Habilayn
Aden
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Tarim
Seiyun
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Jijiga
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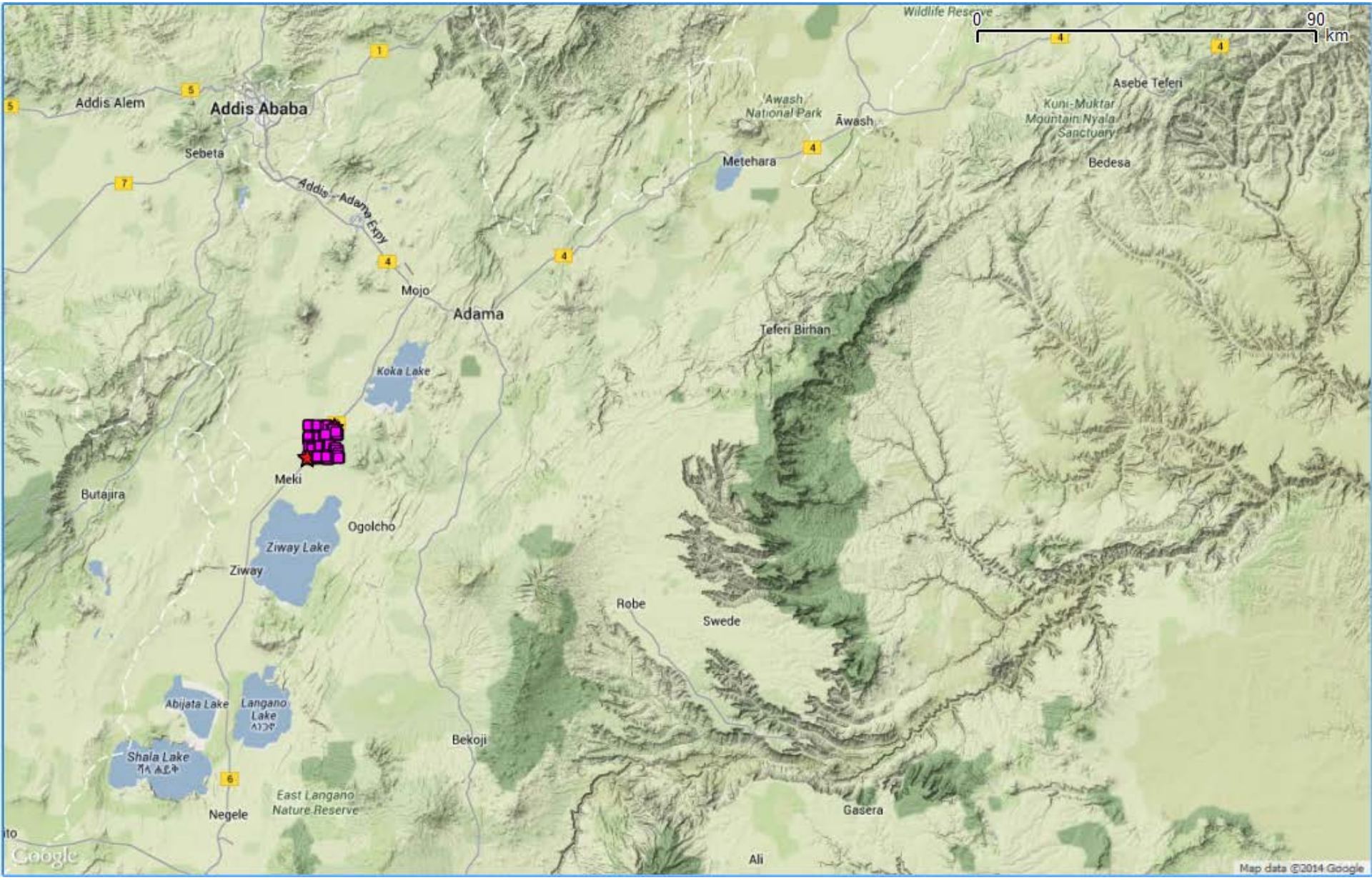
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East Langano Nature Reserve
Gasera
Ali
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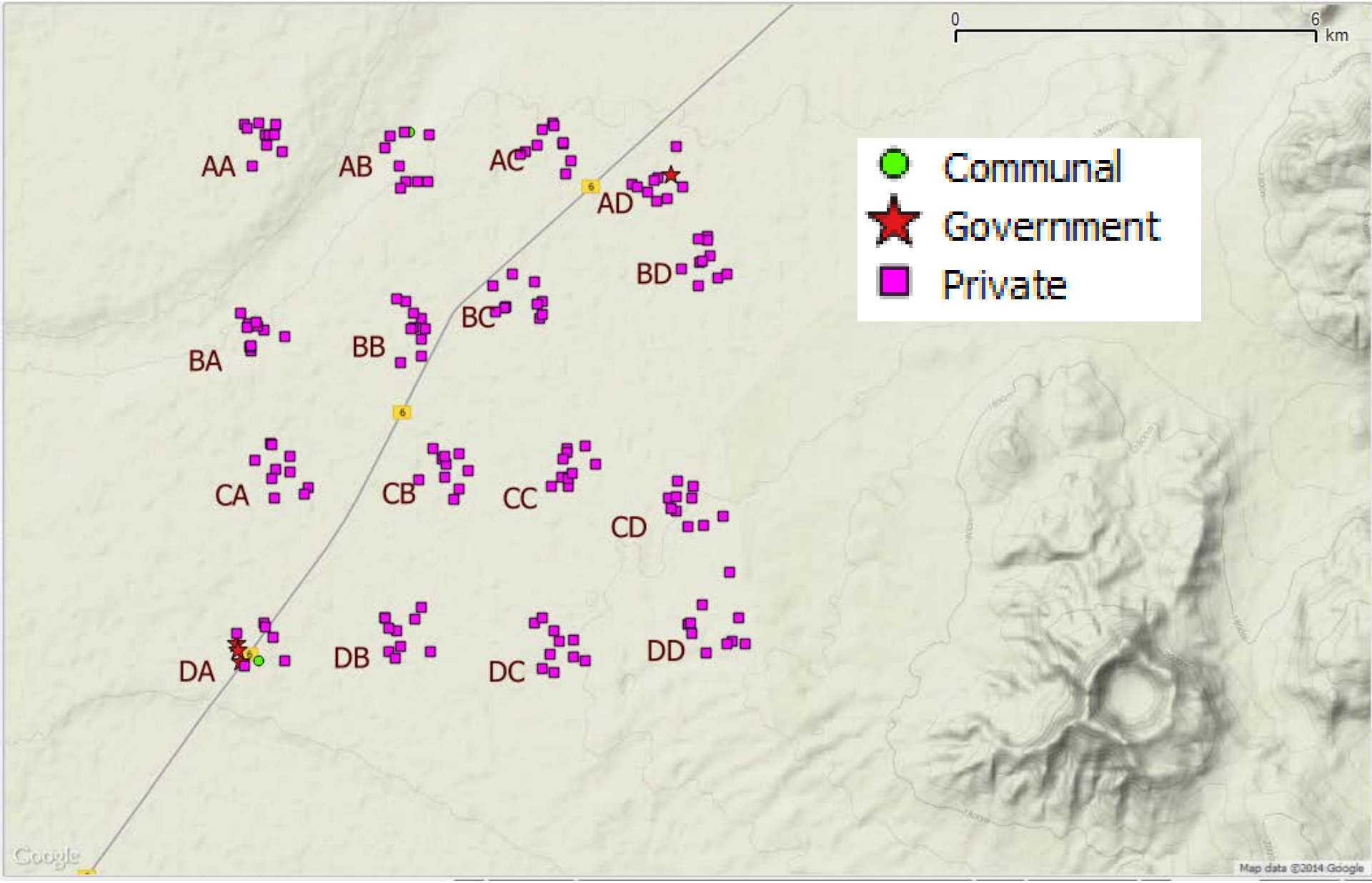
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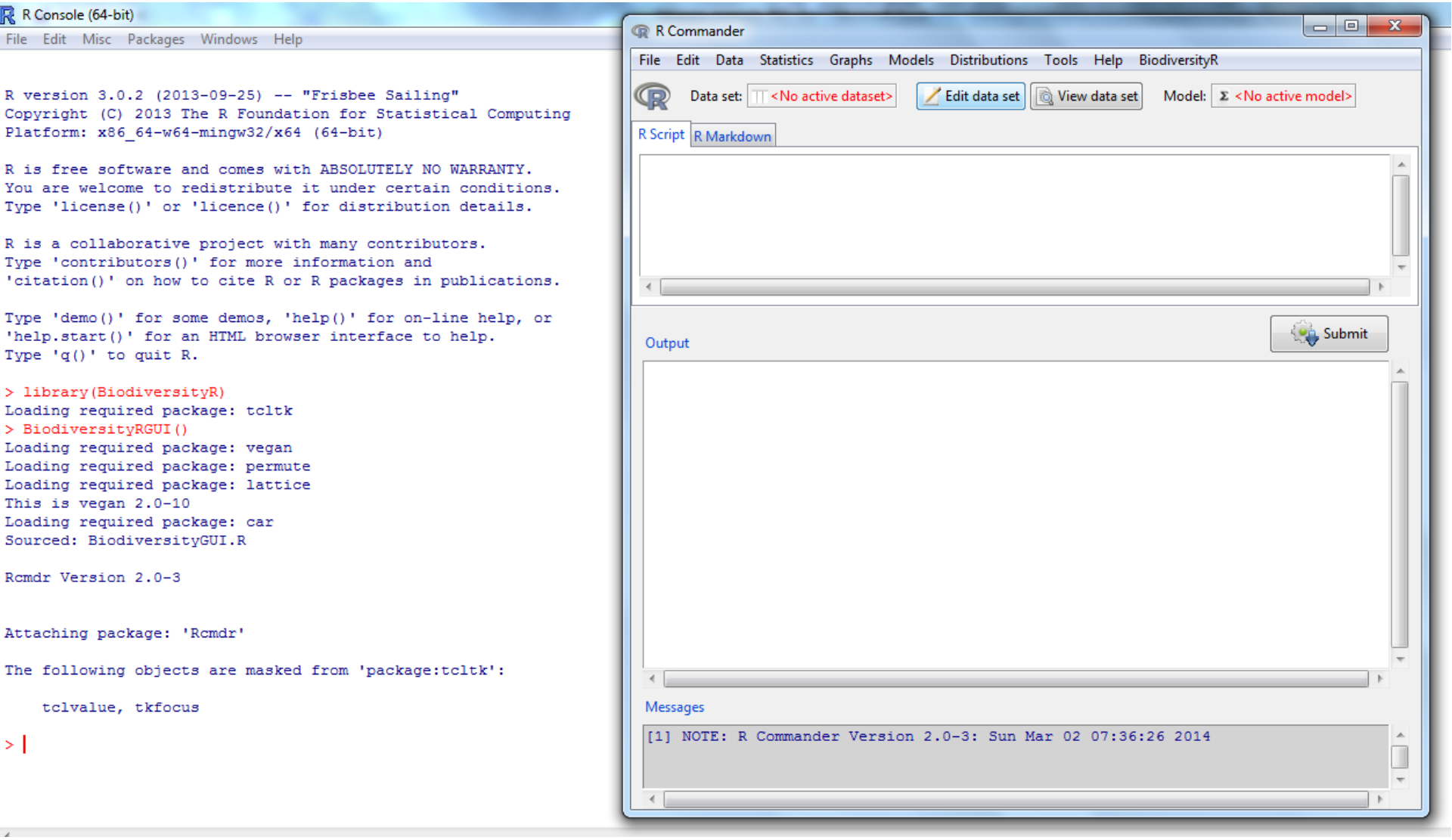
R Console (64-bit)
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R version 3.0.2 (2013-09-25) -- "Frisbee Sailing"
Copyright (C) 2013 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)
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Type 'license()' or 'licence()' for distribution details.
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.
Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.
> library(BiodiversityR)
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tclvalue, tkfocus
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R Commander
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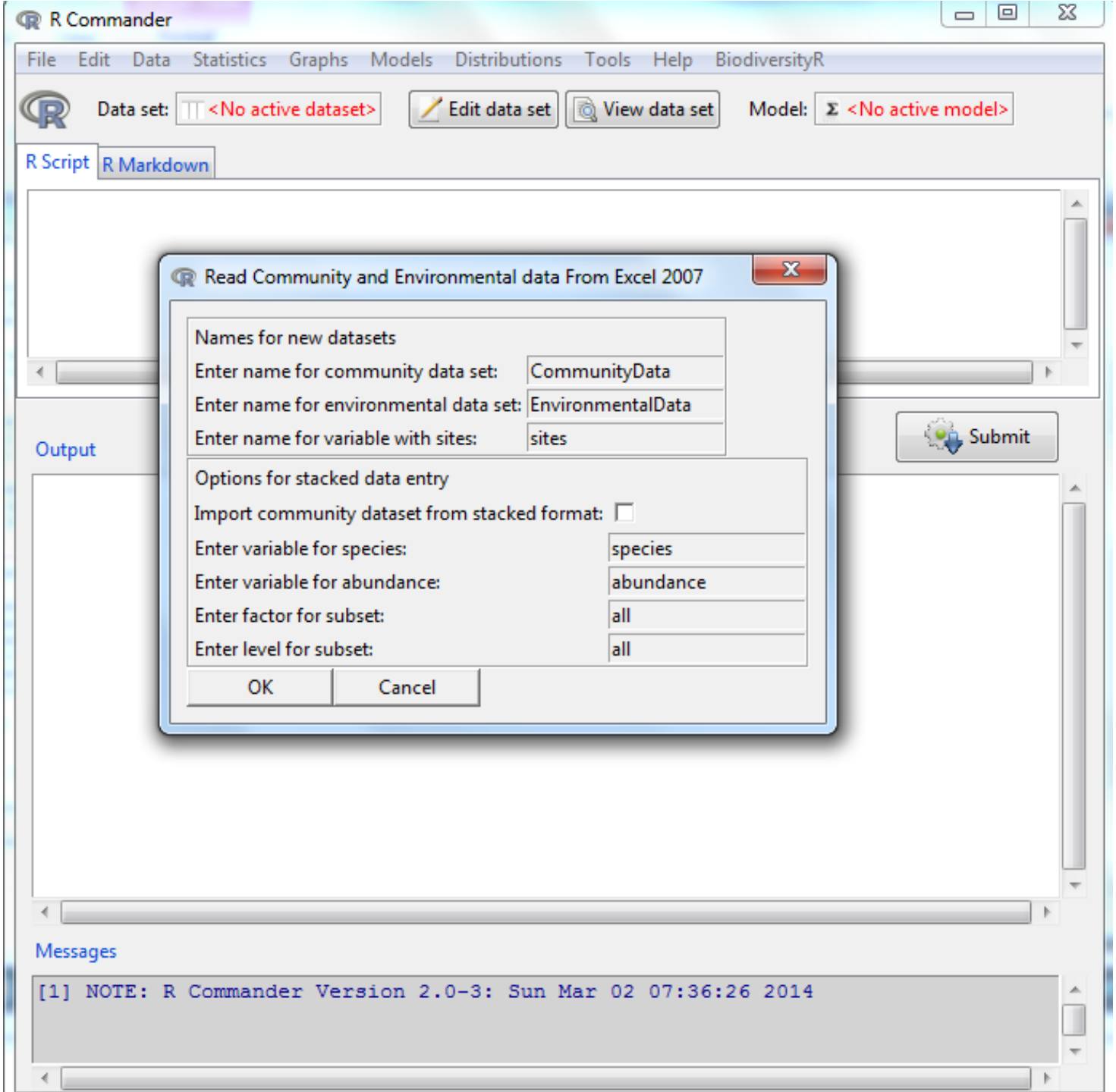
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Enter variable for abundance: abundance
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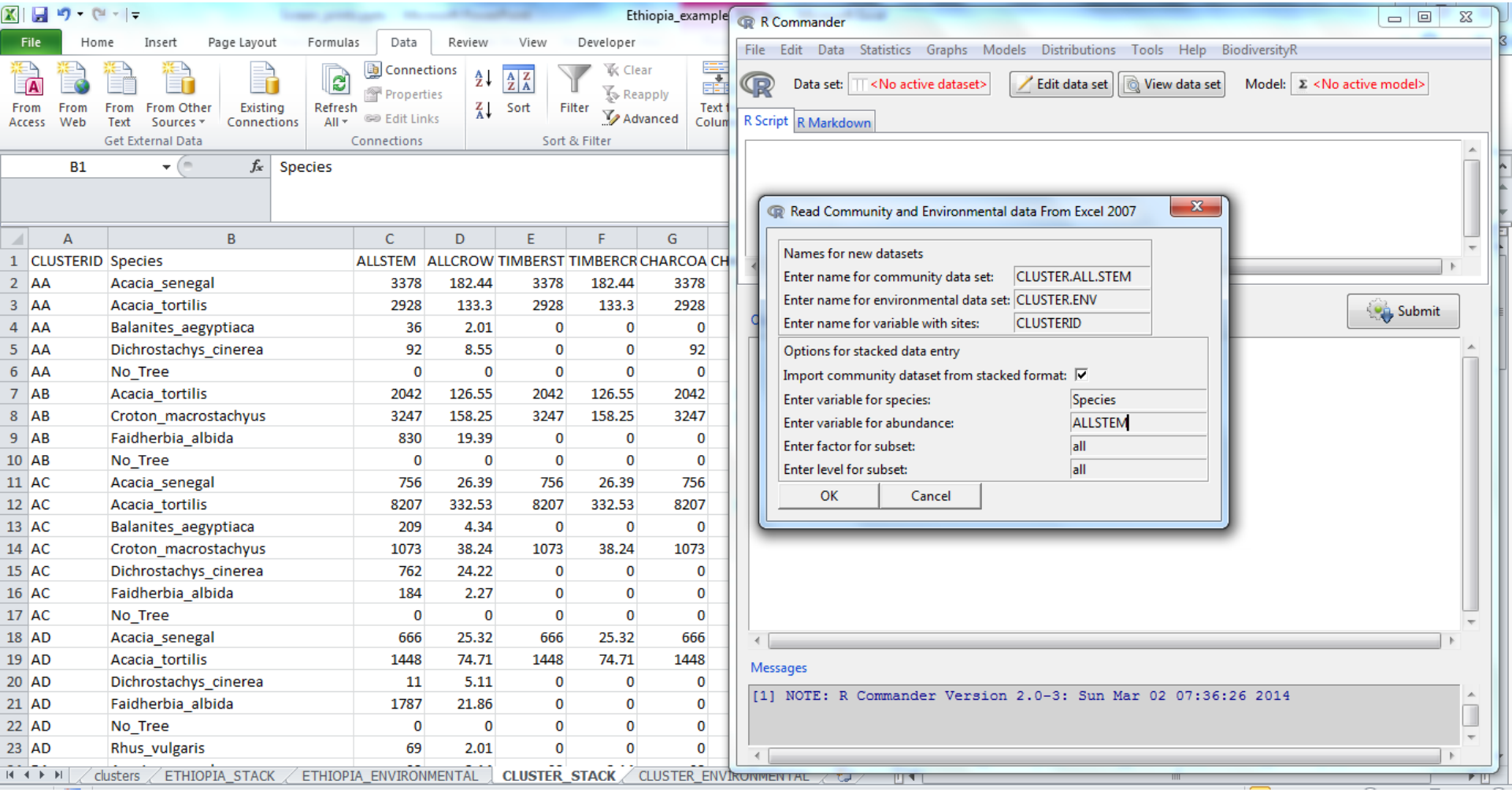
[1] NOTE: R Commander Version 2.0-3: Sun Mar 02 07:36:26 2014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From Web
From Text
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Refresh All
Connections
Properties
Edit Links
Connections
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Filter
Clear
Reapply
Advanced
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B1
Species
CLUSTERID Species ALLSTEM ALLCROW TIMBERST TIMBERCR CHARCOA
AA Acacia_senegal 3378 182.44 3378 182.44 3378
AA Acacia_tortilis 2928 133.3 2928 133.3 2928
AA Balanites_aegyptiaca 36 2.01 0 0 0
AA Dichrostachys_cinerea 92 8.55 0 0 92
AA No_Tree 0 0 0 0 0
AB Acacia_tortilis 2042 126.55 2042 126.55 2042
AB Croton_macrostachyus 3247 158.25 3247 158.25 3247
AB Faidherbia_albida 830 19.39 0 0 0
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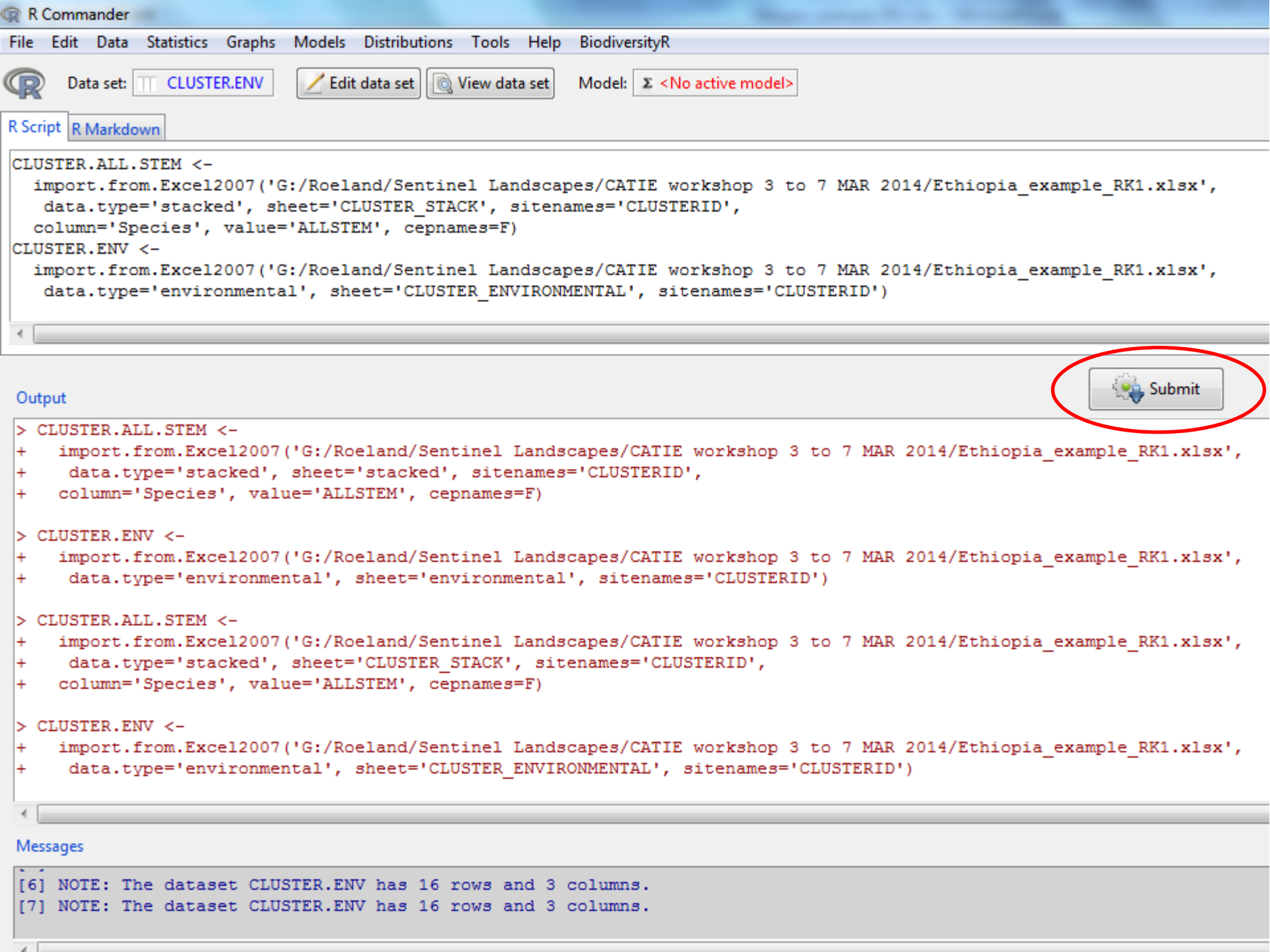
AC Faidherbia_albida 184 2.27 0 0 0
AC No_Tree 0 0 0 0 0
AD Acacia_senegal 666 25.32 666 25.32 666
AD Acacia_tortilis 1448 74.71 1448 74.71 1448
AD Dichrostachys_cinerea 11 5.11 0 0 0
AD Faidherbia_albida 1787 21.86 0 0 0
AD No_Tree 0 0 0 0 0
AD Rhus_vulgaris 69 2.01 0 0 0
clusters
ETHIOPIA_STACK
ETHIOPIA_ENVIRONMENTAL
CLUSTER_STACK
CLUSTER_ENVIRONMENTAL
R Commander
File Edit Data Statistics Graphs Models Distributions Tools Help BiodiversityR
Data set: <No active dataset>
Edit data set
View data set
Model: Σ <No active model>
R Script
R Markdown
Submit
Read Community and Environmental data From Excel 2007
Names for new datasets
Enter name for community data set: CLUSTER.ALL.STEM
Enter name for environmental data set: CLUSTER.ENV
Enter name for variable with sites: CLUSTERID
Options for stacked data entry
Import community dataset from stacked format:
Enter variable for species: Species
Enter variable for abundance: ALLSTEM
Enter factor for subset: all
Enter level for subset: all
OK
Cancel
Messages
[1] NOTE: R Commander Version 2.0-3: Sun Mar 02 07:36:26 2014


R Commander
File Edit Data Statistics Graphs Models Distributions Tools Help BiodiversityR
Data set: CLUSTER.ENV
Edit data set
View data set
Model: <No active model>
R Script
R Markdown
CLUSTER.ALL.STEM <-
import.from.Excel2007('G:/Roeland/Sentinel Landscapes/CATIE workshop 3 to 7 MAR 2014/Ethiopia_example_RK1.xlsx',
data.type='stacked', sheet='CLUSTER_STACK', sitenames='CLUSTERID',
column='Species', value='ALLSTEM', cepnames=F)
CLUSTER.ENV <-
import.from.Excel2007('G:/Roeland/Sentinel Landscapes/CATIE workshop 3 to 7 MAR 2014/Ethiopia_example_RK1.xlsx',
data.type='environmental', sheet='CLUSTER_ENVIRONMENTAL', sitenames='CLUSTERID')
Submit
Output
> CLUSTER.ALL.STEM <-
+ import.from.Excel2007('G:/Roeland/Sentinel Landscapes/CATIE workshop 3 to 7 MAR 2014/Ethiopia_example_RK1.xlsx',
+ data.type='stacked', sheet='stacked', sitenames='CLUSTERID',
+ column='Species', value='ALLSTEM', cepnames=F)
> CLUSTER.ENV <-
+ import.from.Excel2007('G:/Roeland/Sentinel Landscapes/CATIE workshop 3 to 7 MAR 2014/Ethiopia_example_RK1.xlsx',
+ data.type='environmental', sheet='environmental', sitenames='CLUSTERID')
> CLUSTER.ALL.STEM <-
+ import.from.Excel2007('G:/Roeland/Sentinel Landscapes/CATIE workshop 3 to 7 MAR 2014/Ethiopia_example_RK1.xlsx',
+ data.type='stacked', sheet='CLUSTER_STACK', sitenames='CLUSTERID',
+ column='Species', value='ALLSTEM', cepnames=F)
> CLUSTER.ENV <-
+ import.from.Excel2007('G:/Roeland/Sentinel Landscapes/CATIE workshop 3 to 7 MAR 2014/Ethiopia_example_RK1.xlsx',
+ data.type='environmental', sheet='CLUSTER_ENVIRONMENTAL', sitenames='CLUSTERID')
Messages
[6] NOTE: The dataset CLUSTER.ENV has 16 rows and 3 columns.
[7] NOTE: The dataset CLUSTER.ENV has 16 rows and 3 columns.

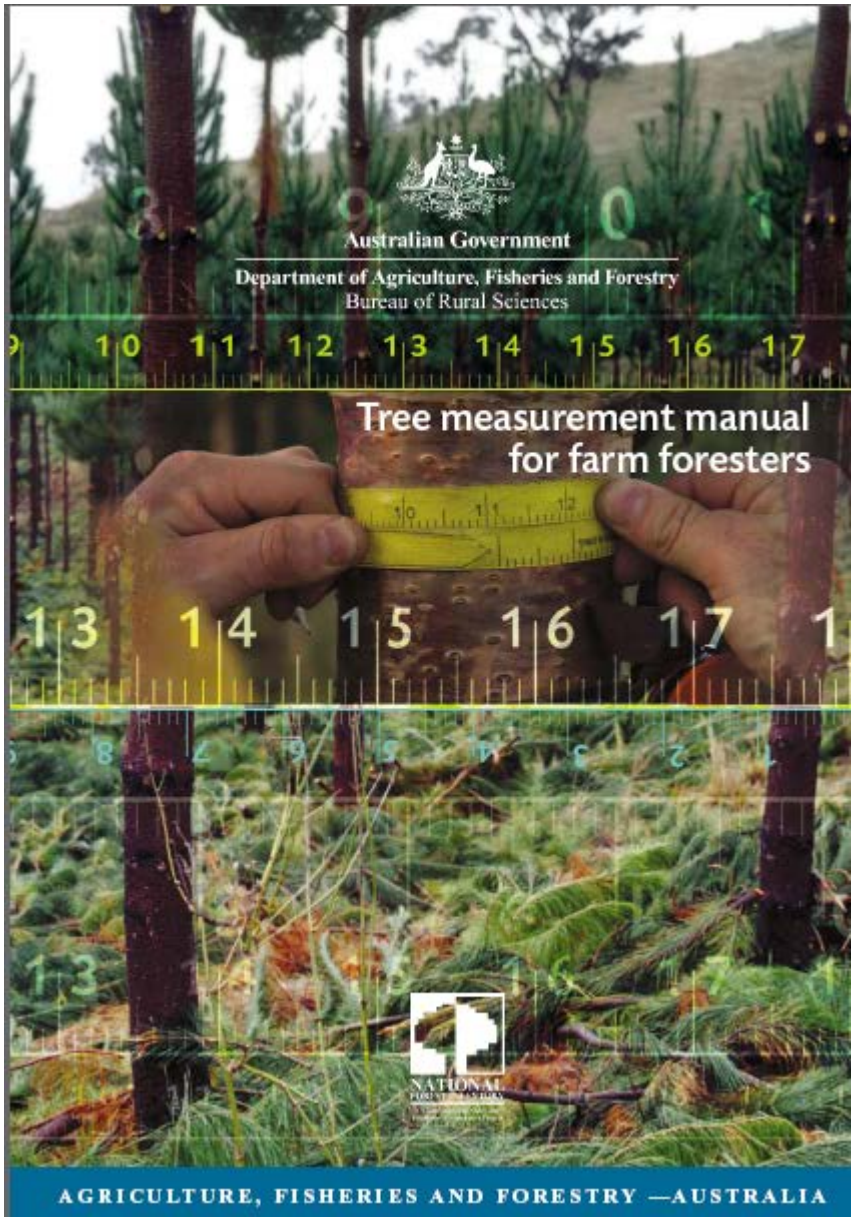
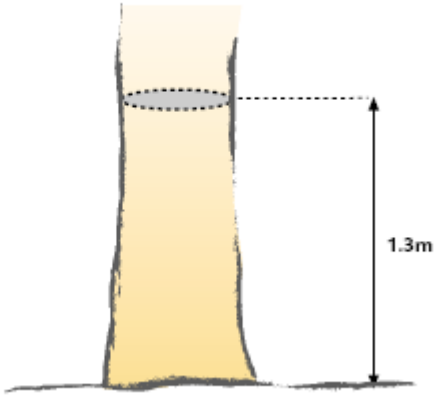
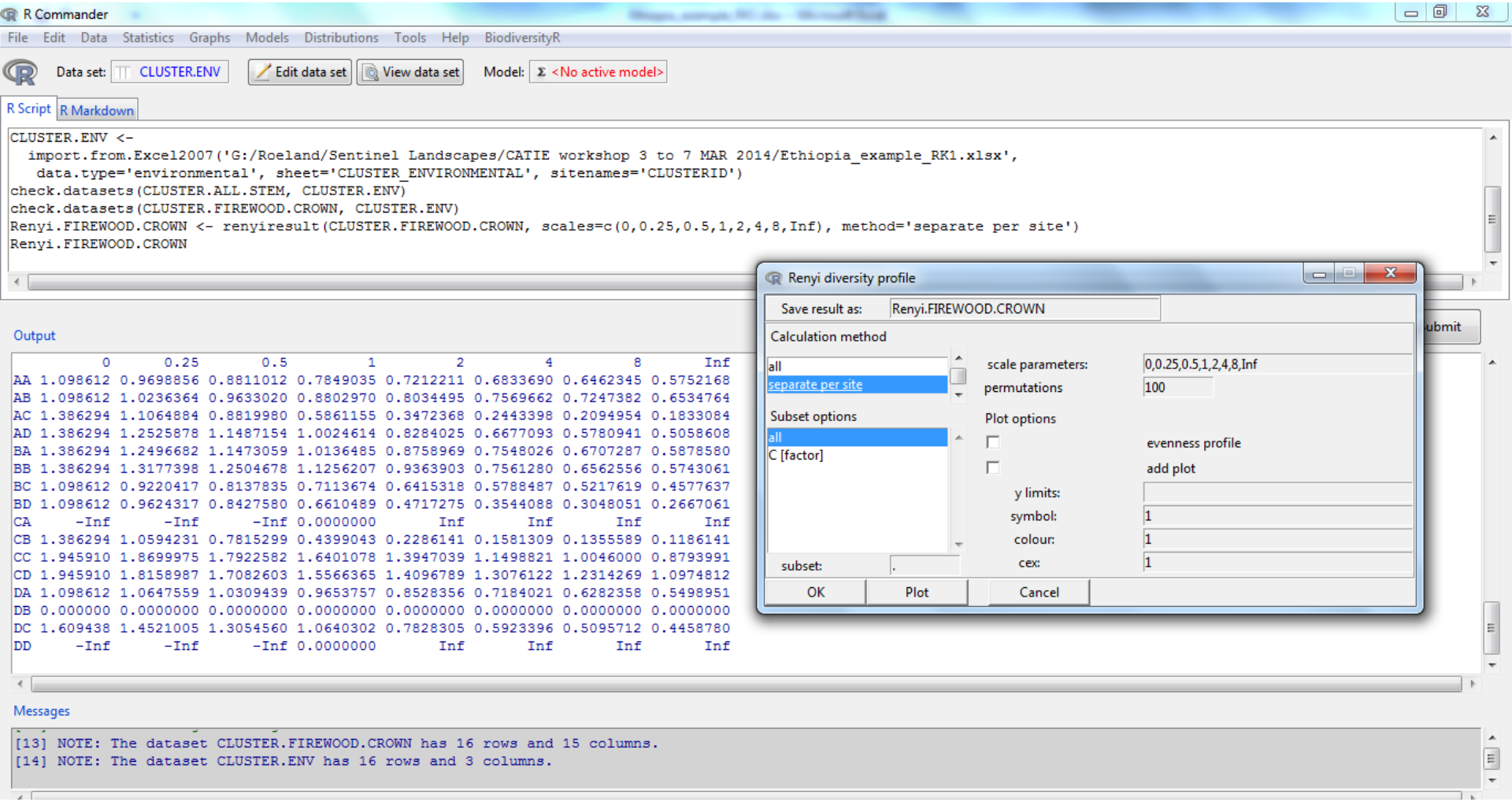


FIGURE 6.2: TREE BASAL AREA AT 1.3 M

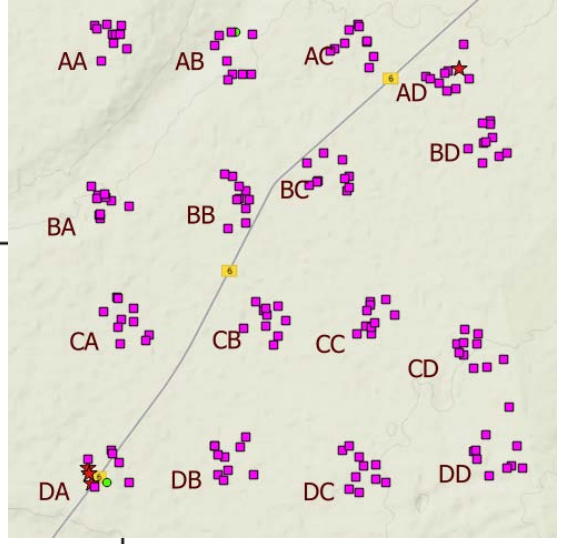


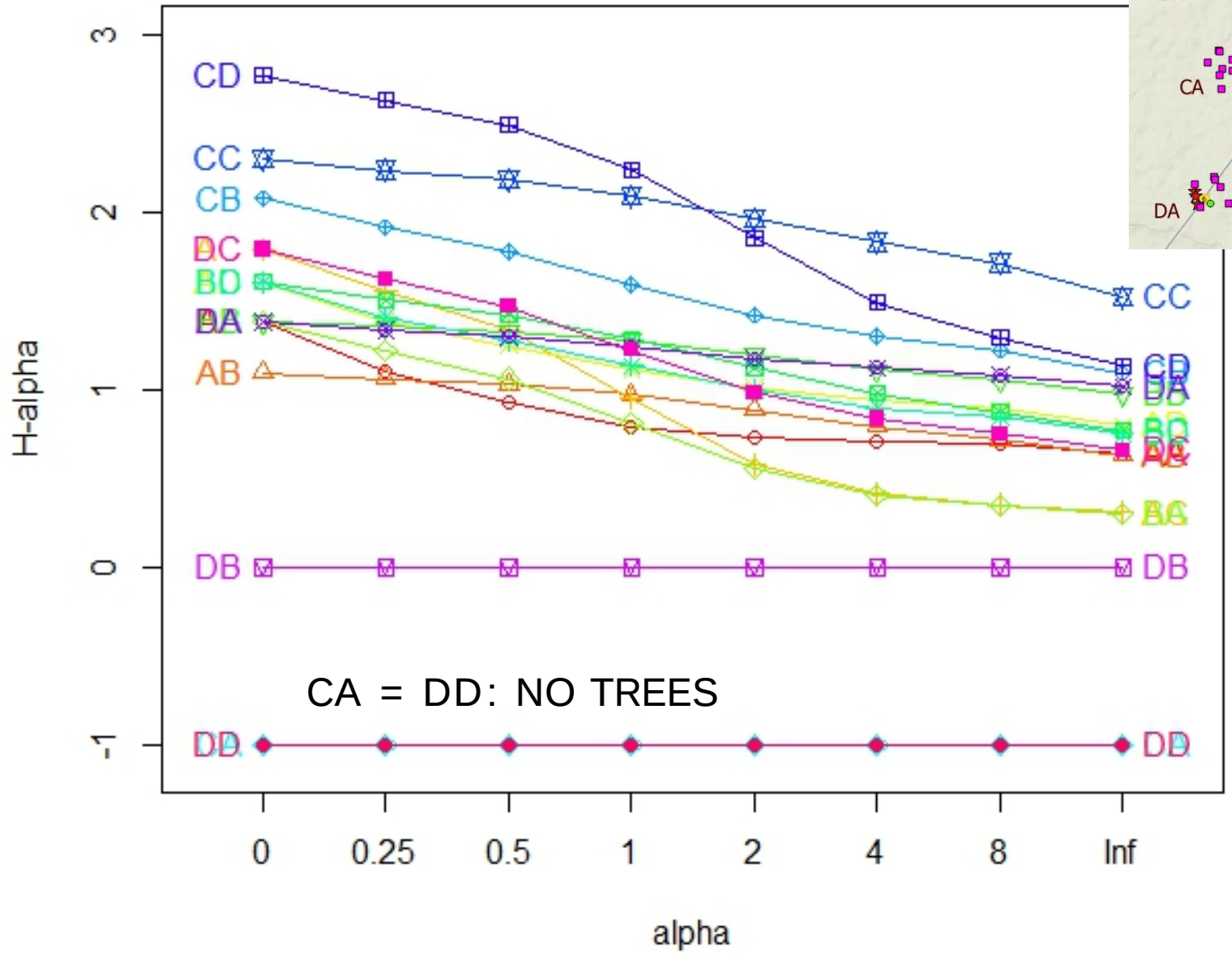
$$BASAL.AREA = \pi r^2$$

$$CROWN.AREA = \pi \left(\frac{R_1 + R_2}{2}\right)^2$$

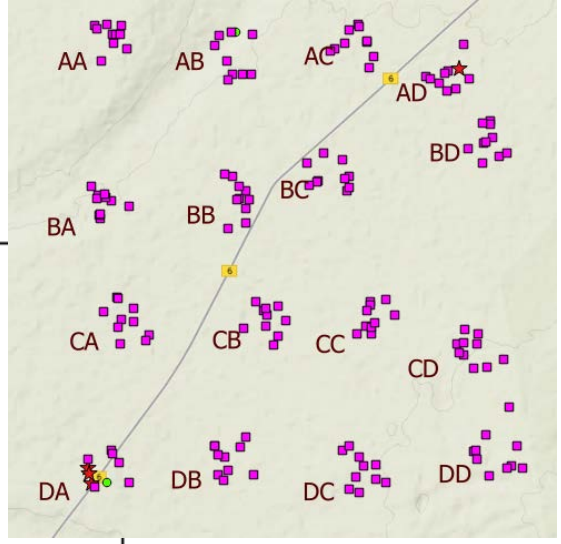

R Commander
File Edit Data Statistics Graphs Models Distributions Tools Help BiodiversityR
Data set: CLUSTER.ENV
Edit data set
View data set
Model: <No active model>
R Script
R Markdown
CLUSTER.ENV <-
import.from.Excel2007('G:/Roeland/Sentinel Landscapes/CATIE workshop 3 to 7 MAR 2014/Ethiopia_example_RK1.xlsx',
data.type='environmental', sheet='CLUSTER_ENVIRONMENTAL', sitenames='CLUSTERID')
check.datasets(CLUSTER.ALL.STEM, CLUSTER.ENV)
check.datasets(CLUSTER.FIREWOOD.CROWN, CLUSTER.ENV)
Renyi.FIREWOOD.CROWN <- renyiresult(CLUSTER.FIREWOOD.CROWN, scales=c(0,0.25,0.5,1,2,4,8,Inf), method='separate per site')
Renyi.FIREWOOD.CROWN
Output
0 0.25 0.5 1 2 4 8 Inf
AA 1.098612 0.9698856 0.8811012 0.7849035 0.7212211 0.6833690 0.6462345 0.5752168
AB 1.098612 1.0236364 0.9633020 0.8802970 0.8034495 0.7569662 0.7247382 0.6534764
AC 1.386294 1.1064884 0.8819980 0.5861155 0.3472368 0.2443398 0.2094954 0.1833084
AD 1.386294 1.2525878 1.1487154 1.0024614 0.8284025 0.6677093 0.5780941 0.5058608
BA 1.386294 1.2496682 1.1473059 1.0136485 0.8758969 0.7548026 0.6707287 0.5878580
BB 1.386294 1.3177398 1.2504678 1.1256207 0.9363903 0.7561280 0.6562556 0.5743061
BC 1.098612 0.9220417 0.8137835 0.7113674 0.6415318 0.5788487 0.5217619 0.4577637
BD 1.098612 0.9624317 0.8427580 0.6610489 0.4717275 0.3544088 0.3048051 0.2667061
CA -Inf -Inf -Inf 0.0000000 Inf Inf Inf Inf
CB 1.386294 1.0594231 0.7815299 0.4399043 0.2286141 0.1581309 0.1355589 0.1186141
CC 1.945910 1.8699975 1.7922582 1.6401078 1.3947039 1.1498821 1.0046000 0.8793991
CD 1.945910 1.8158987 1.7082603 1.5566365 1.4096789 1.3076122 1.2314269 1.0974812
DA 1.098612 1.0647559 1.0309439 0.9653757 0.8528356 0.7184021 0.6282358 0.5498951
DB 0.000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0000000
DC 1.609438 1.4521005 1.3054560 1.0640302 0.7828305 0.5923396 0.5095712 0.4458780
DD -Inf -Inf -Inf 0.0000000 Inf Inf Inf Inf
Messages
[13] NOTE: The dataset CLUSTER.FIREWOOD.CROWN has 16 rows and 15 columns.
[14] NOTE: The dataset CLUSTER.ENV has 16 rows and 3 columns.
Renyi diversity profile
Save result as: Renyi.FIREWOOD.CROWN
Calculation method
all
separate per site
Subset options
all
C [factor]
subset: .
scale parameters: 0,0.25,0.5,1,2,4,8,Inf
permutations 100
Plot options
evenness profile
add plot
y limits:
symbol: 1
colour: 1
cex: 1
OK
Plot
Cancel

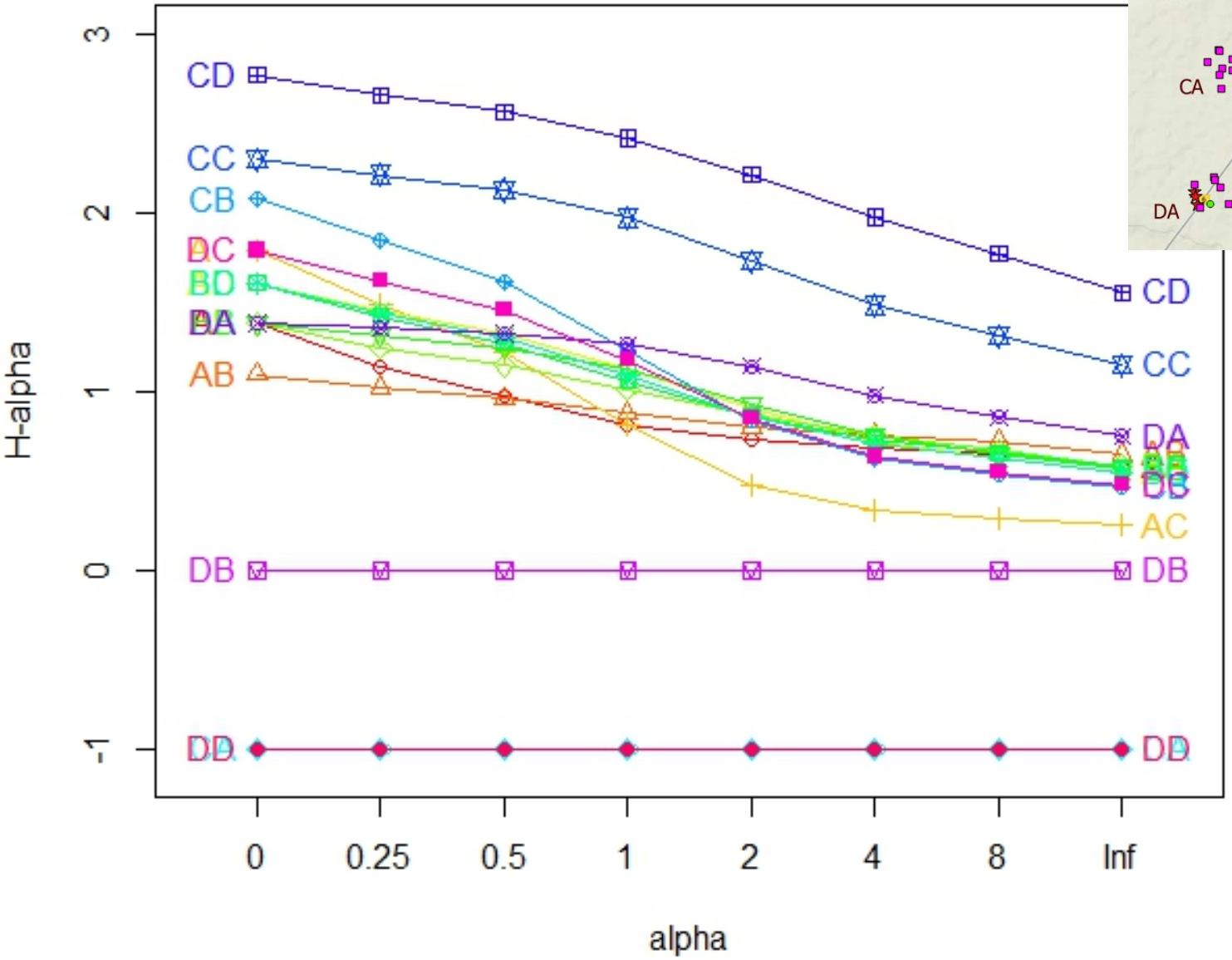
All trees, basal area





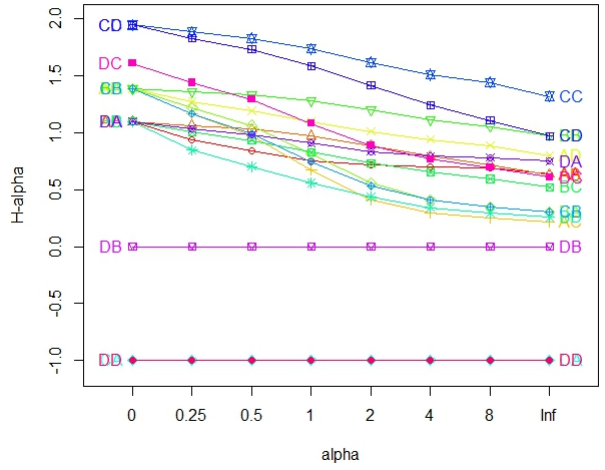
All trees, crown area



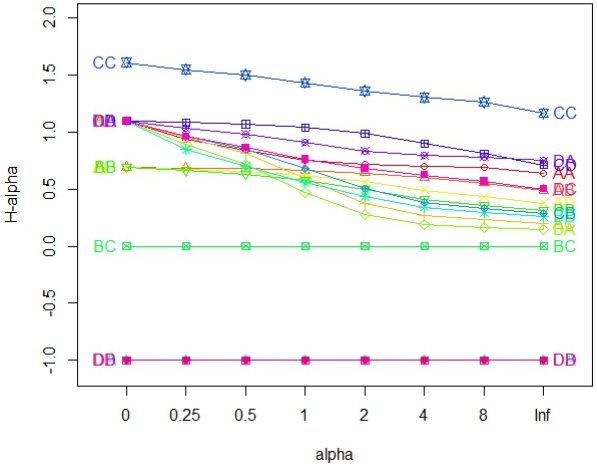


Frequencies calculated from basal area

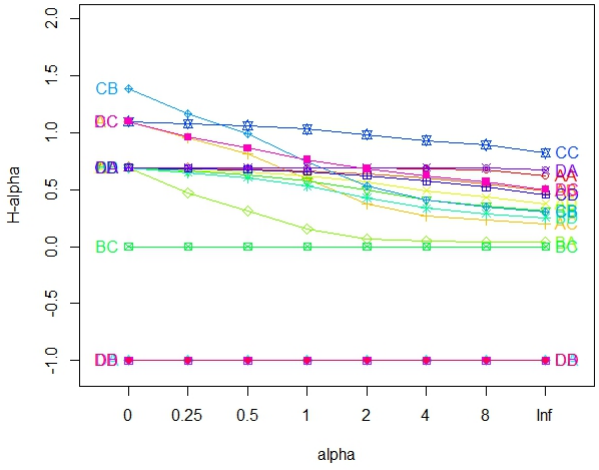
FIREWOOD



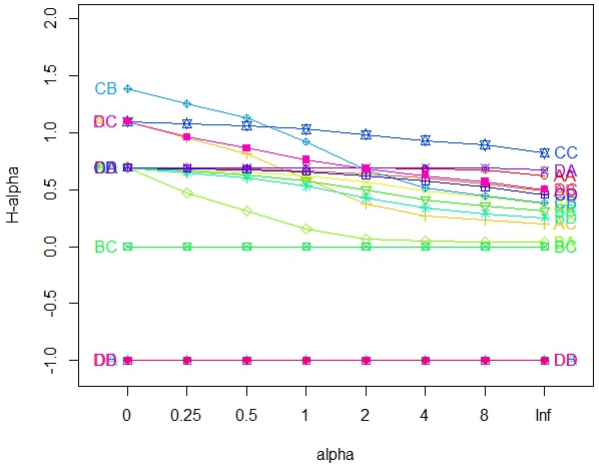
CHARCOAL



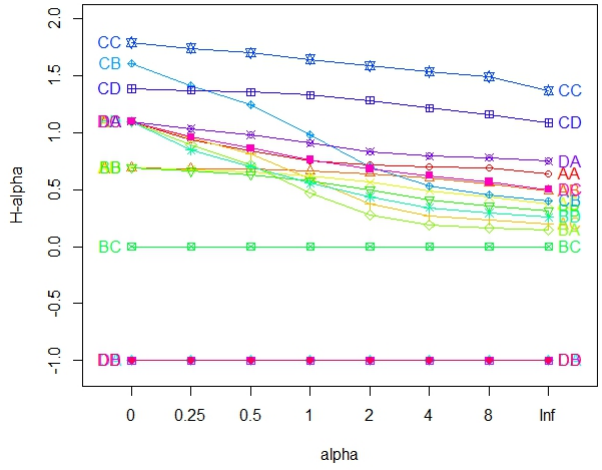
TIMBER



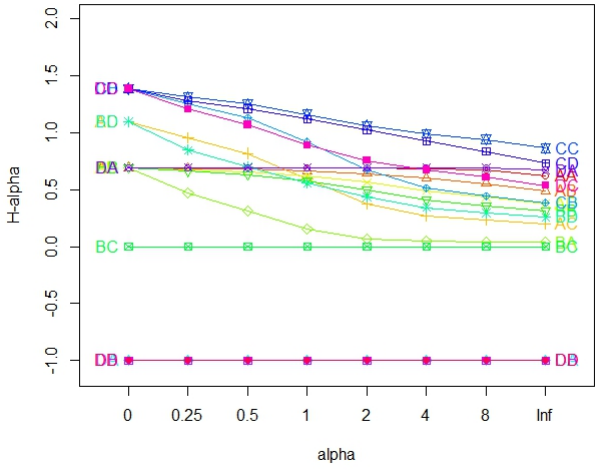
FODDER



SHADE

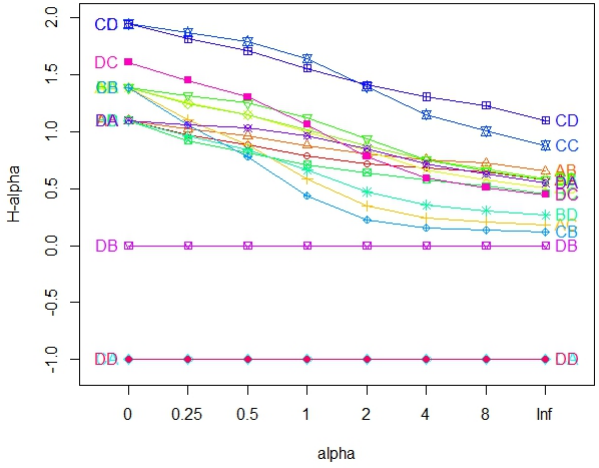


LIFE FENCE

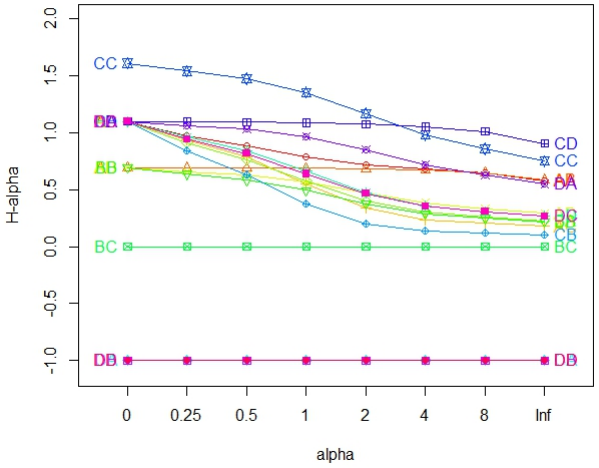


Frequencies calculated from crown area

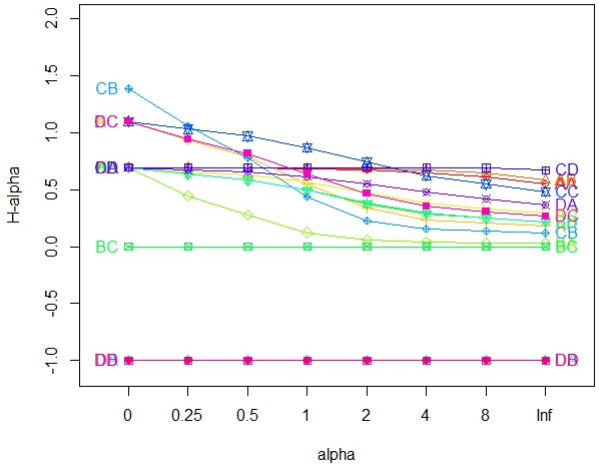
FIREWOOD



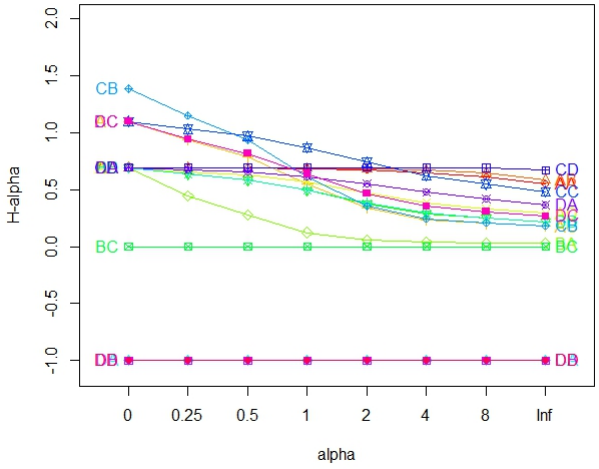
CHARCOAL



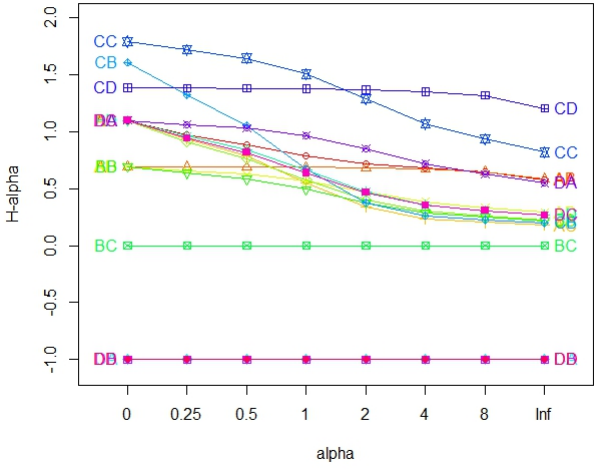
TIMBER



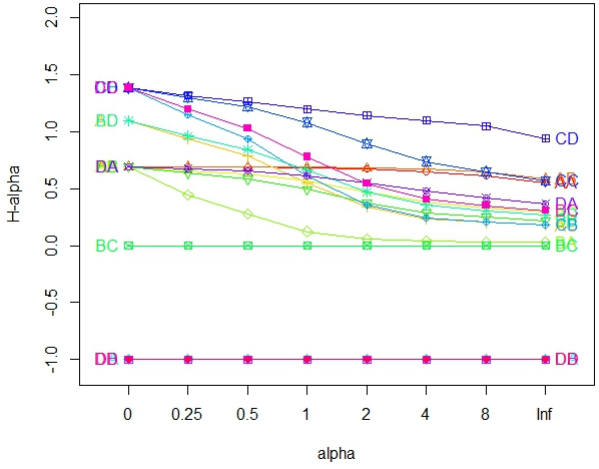
FODDER



SHADE

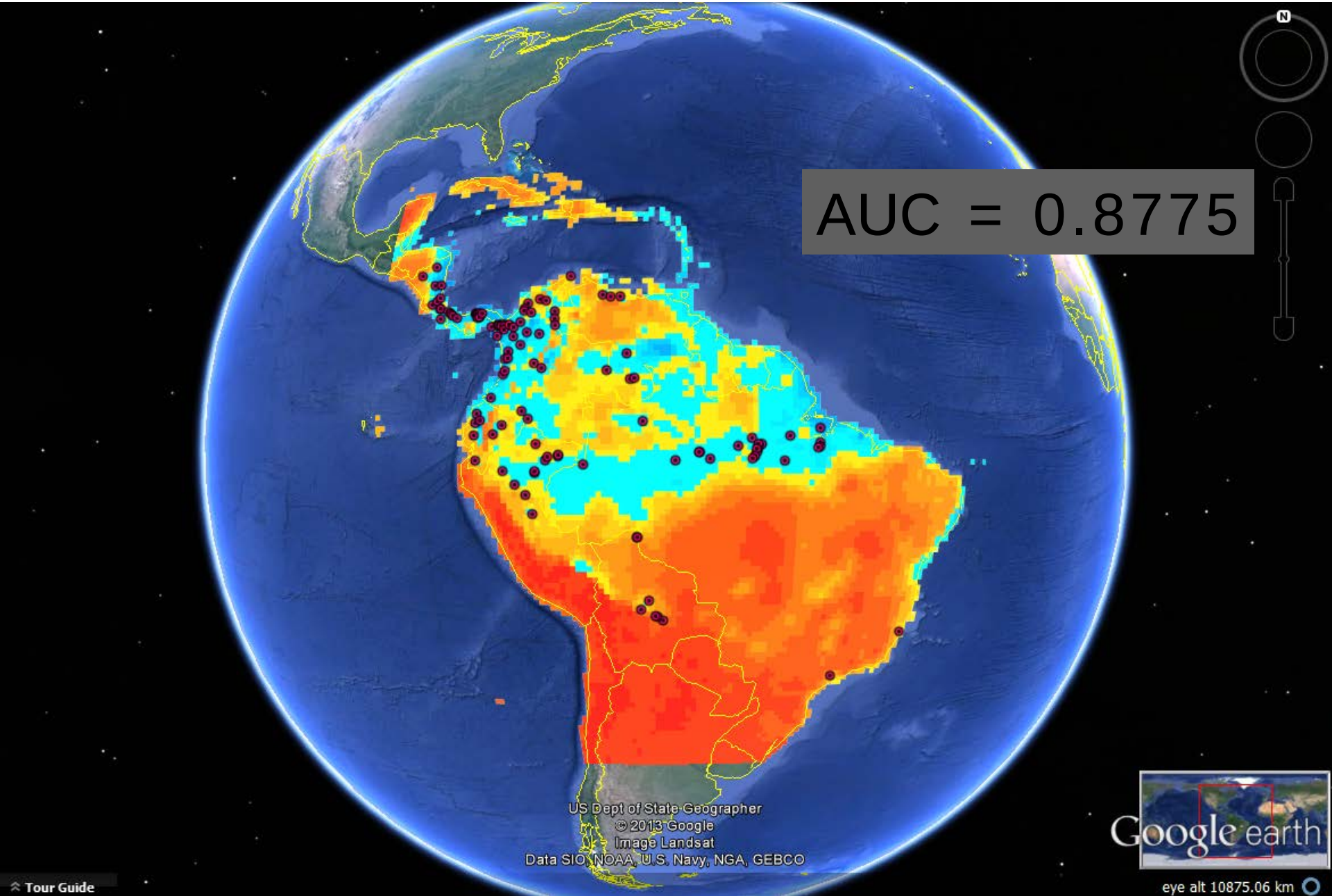


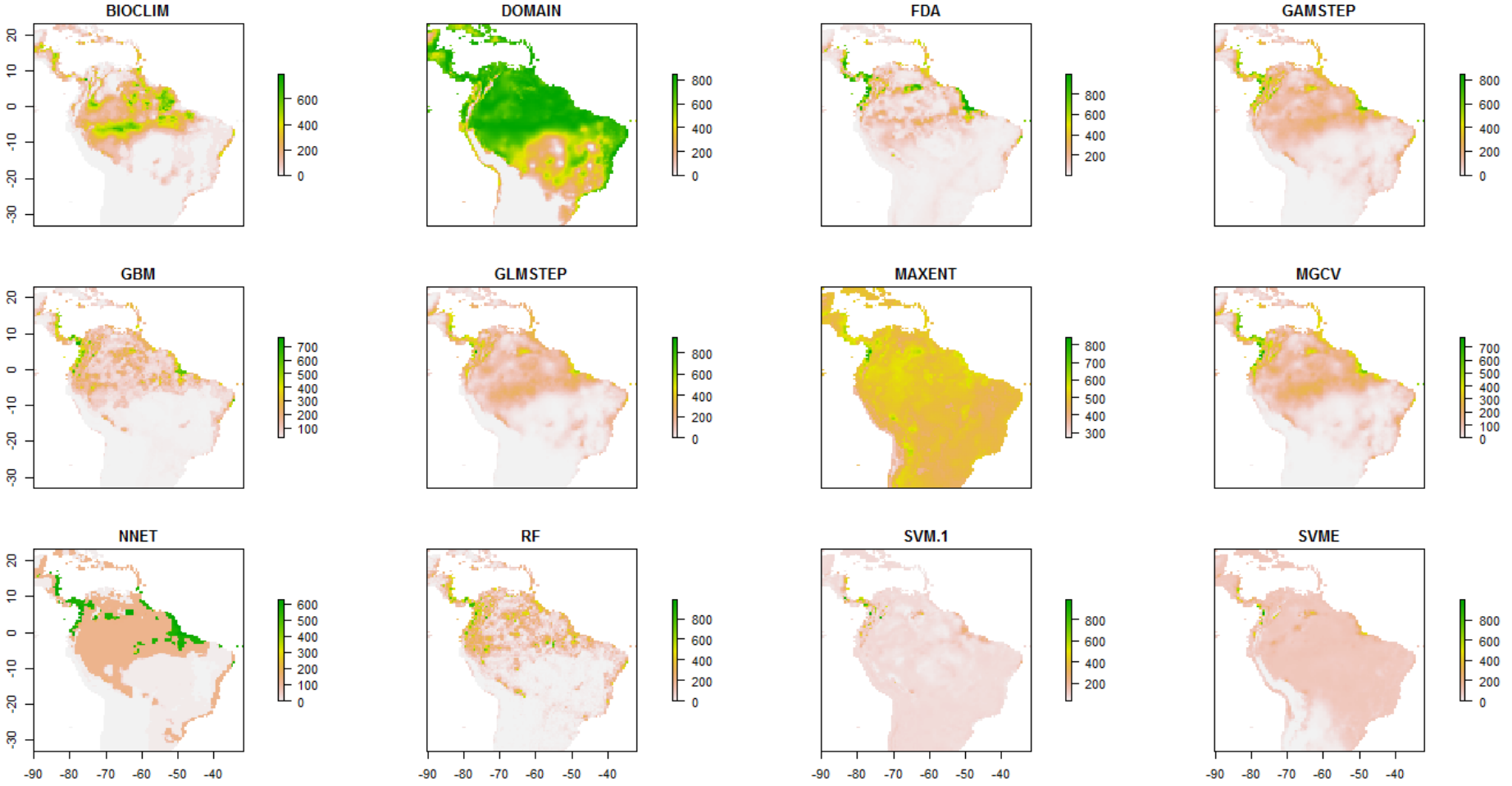
LIFE FENCE



... short commercial break

Ensemble suitability modelling



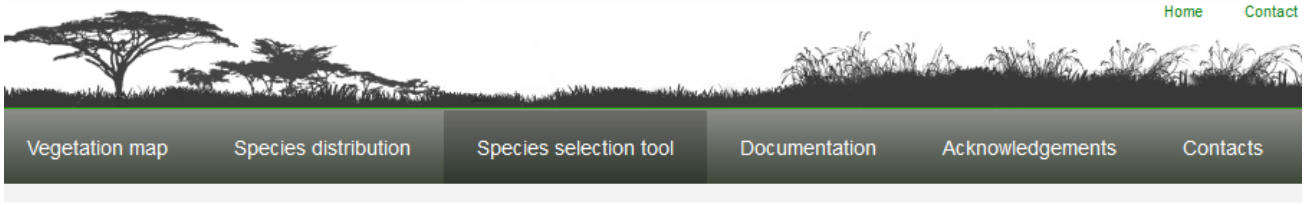


Ensemble = (weighted) average of different Modeling algorithms such as random forests (RF), Maximum Entropy (MAXENT) or Support Vector Machines (SVM, SVME)

$$P_{ensemble} = \frac{\sum (w_{\mathrm{mod}} P_{\mathrm{mod}})}{\sum w_{\mathrm{mod}}}$$

VECEA: A higher resolution map for 7 countries in eastern Africa
(Ethiopia, Kenya, Malawi, Rwanda, Uganda, Tanzania and Zambia)

http://www.vegetationmap4africa.org



Vegetation map

Individual PNVs
Versioning info
Mobile maps
Reference maps
Other resources
Web-based maps

A map of the potential natural vegetation of eastern Africa

The map of potential natural vegetation of eastern Africa, version 1.1, gives the distribution of potential natural vegetation in Ethiopia, Kenya, Tanzania, Uganda, Rwanda, Malawi and Zambia. The map distinguishes 47 vegetation types, divided in four main vegetation groups: 15 forest types, 15 woodland and wooded grassland types, 5 bushland and thicket types and 12 other types. Furthermore, a number of compound vegetation types are mapped, which include vegetation mosaics, catena's and transitional zones.

Google Earth layer

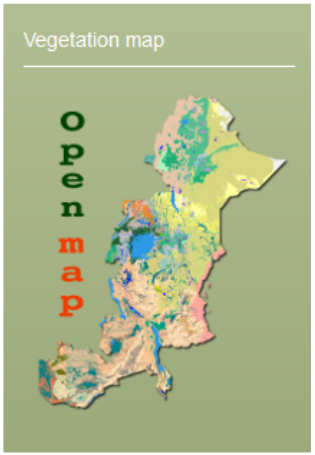
The potential vegetation map of east Africa is available as a Google Earth layer. You can open the layer by clicking the image below. It will open the map and a separate layer with the codes of the potential natural vegetation (PNV) units. To find the meaning of the PNV codes, go to the legend and select the code you are interested in. This will open a popup window with the vegetation name and a link to a fact sheet (not implemented for all countries yet).

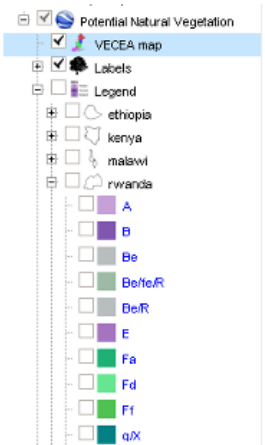
Documentation

The floristic, physiognomic and other characteristics of the different PNVs are documented in a series of reports which you can find on the documentation page. The map is furthermore linked to the species selection tool, which provides information about the suitability of woody species within the different vegetation types.

Your feedback

We are always striving to improve the map. If you have information that could help us to improve the map, we would be very happy to hear from you. If you want to know who was involved in or supported the development of the map and other tools, check here.

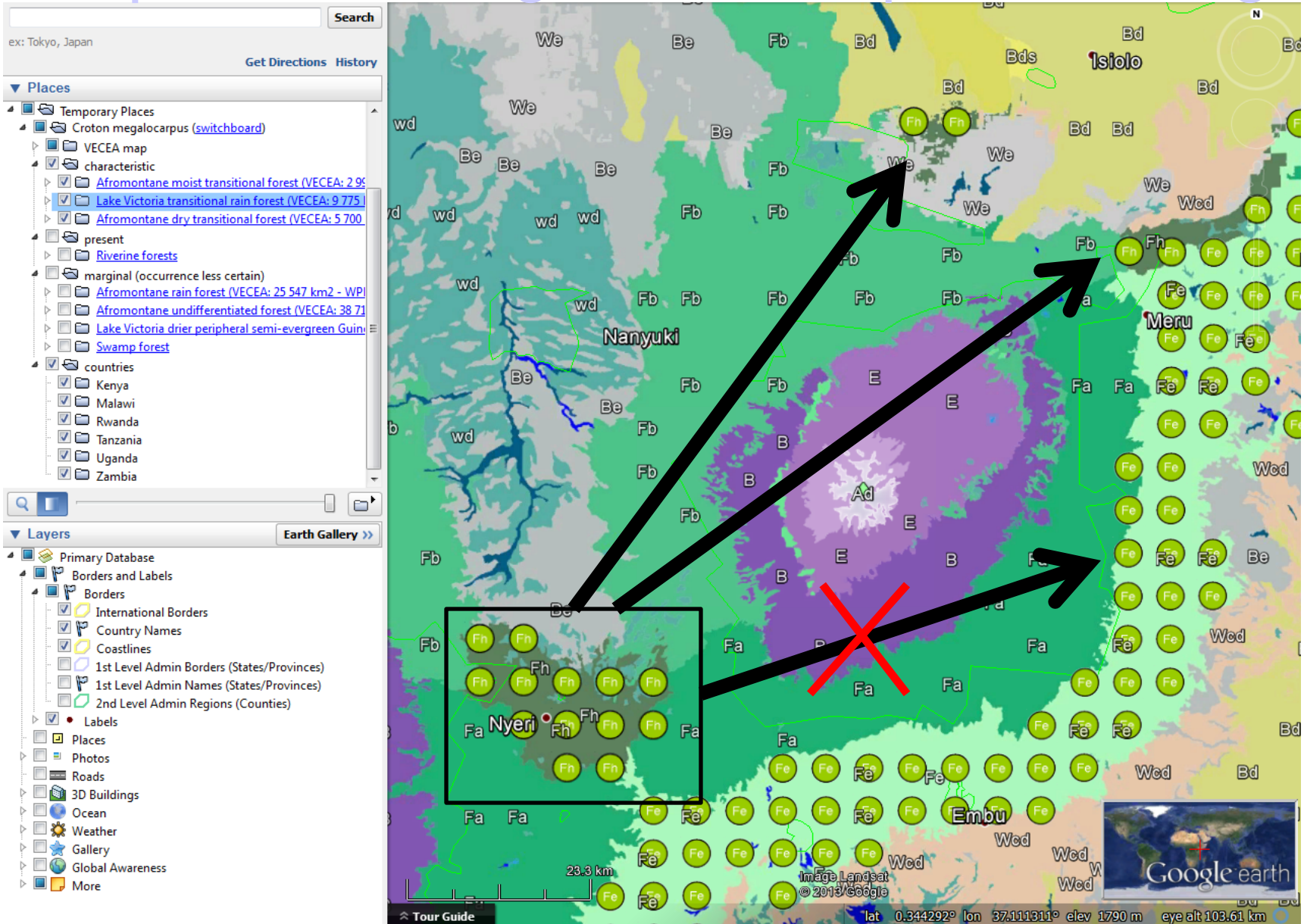




Application domains:
- Climate change modelling
- Species selection
- Seed source selection
- (agro)ecological zonation
- Protected area evaluation
- Species distribution mapping

Seed sources and seed zones

http://www.vegetationmap4africa.org



Agroforestry Species Switchboard

http://www.worldagroforestry.org/our_products/databases/switchboard

Agroforestry Species Switchboard 1.0

About the Switchboard

Suggested citation: Kindt R, Ordonez J, Smith E, Orwa C, Harja D,Kehlenbeck K, Luedeling E, Munjuga M, Mwanzia L, Sinclair F and Jamnadass R. 2013. ICRAF Species Switchboard. Version 1.0. World Agroforestry Centre, Nairobi.

World Agroforestry Centre

ziziphus

Your results for the search term: **'ziziphus'**

1 2 >

Names found	Current Name (Click to show database links)
Ziziphus abyssinica	Ziziphus abyssinica
Ziziphus atacorensis	Ziziphus abyssinica
Ziziphus amole	Ziziphus amole
Ziziphus arborea	Ziziphus arborea
Ziziphus calophylla	Ziziphus calophylla
Ziziphus celtidifolia	Ziziphus celtidifolia
Ziziphus cinnamomum	Ziziphus cinnamomum
Ziziphus grewioides	Ziziphus grewioides
Ziziphus hamur	Ziziphus hamur
Ziziphus inermis	Ziziphus inermis
Ziziphus itacaiunensis	Ziziphus itacaiunensis
Ziziphus jujuba	Ziziphus jujuba
Ziziphus sativa	Ziziphus jujuba
Ziziphus vulgaris	Ziziphus jujuba
Ziziphus lotus	Ziziphus lotus
Ziziphus mauritiana	Ziziphus mauritiana

ICRAF Databases	Links to Ziziphus mauritiana
Agroforestree Database	View
Tree Seed Suppliers Directory	View
The African Wood Density Database	Not Listed
The Tree Functional Attributes and Ecological Database	Not Listed
The Useful Tree Species for Africa	Spreadsheet
The VECEA interactive vegetation map	Listed
Other Databases	Links to Ziziphus mauritiana
Árboles de Centroamérica project	Not Listed
Eco-crop Database	View
Plant Resources of South East Asia	View
Plant Resources of Tropical Africa	View
Tropical Forages	Not Listed
TRY Database	Search
Global Wood Density Database	Search
The Plant List	Search
Tropicos	Search
Royal Botanic Gardens, KEW	Search
The Global Biodiversity Information Facility	Search
The UNEP-WCMC Species Database	Search
The UNEP-WCMC CITES-Listed Species Database	Search