Appendix 1 - sPlotOpen - Demo

Francesco Maria Sabatini, Jonathan Lenoir, Helge Bruelheide

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Appendix to the paper: Sabatini, Lenoir et al., sPlotOpen – An environmentally-balanced, open-access, global dataset of vegetation plots. *Global Ecology and Biogeography*.

This demo illustrates how to import and manipulate sPlotOpen data to create some basic graphics or tables together with a reference list. As a worked example, the code below will:

1. select all plots containing at least a species of *Quercus* from sPlotOpen's resampled iteration #1
2. show some summary at biome level
3. graph the distribution of the community weighted mean of a selected functional trait
4. show the geographical location of all selected plots
5. create a reference list based on the plots effectively selected.

```
#load libraries
library(tidyverse)
library(sf)
library(raster)
library(rnaturalearth)
library(RefManageR)
```

Import data

```
load("_sPlotOpenDB/sPlotOpen.RData")
ls()
```

```
## [1] "CWM_CWV.oa"         "DT2.oa"             "header.oa"
## [4] "metadata.oa"        "reference.oa"       "sPlotOpen_citation"
```

Extract all plots containing at least a *Quercus* species

Use only the first resampled iteration of sPlotOpen

```
#select only the first resample
header.oa1 <- header.oa %>%
  filter(Resample_1 == T)
DT2.oa1 <- DT2.oa %>%
  filter(PlotObservationID %in% header.oa1$PlotObservationID)
CWM_CWV.oa1 <- CWM_CWV.oa %>%
  filter(PlotObservationID %in% header.oa1$PlotObservationID)
```

```
#get all plots containing at least one Quercus species
plotlist.quercus <- DT2.oa1 %>%
```

```
  filter(str_detect(Species, "^Quercus")) %>%
  distinct(PlotObservationID) %>%
  pull(PlotObservationID)

header.quercus <- header.oa1 %>%
  filter(PlotObservationID %in% plotlist.quercus &
           Resample_1 == T)

DT2.quercus <- DT2.oa1 %>%
  filter(PlotObservationID %in% plotlist.quercus)

CWM_CWV.quercus <- CWM_CWV.oa1 %>%
  mutate(Quercus=ifelse(PlotObservationID %in% plotlist.quercus, T, F))
```

There are 5143 plots containing at least a *Quercus* species in sPlotOpen's resampled iteration 1.

Number of plots with *Quercus* across biomes

Summarize the number of plots containing at least one *Quercus* species across biomes

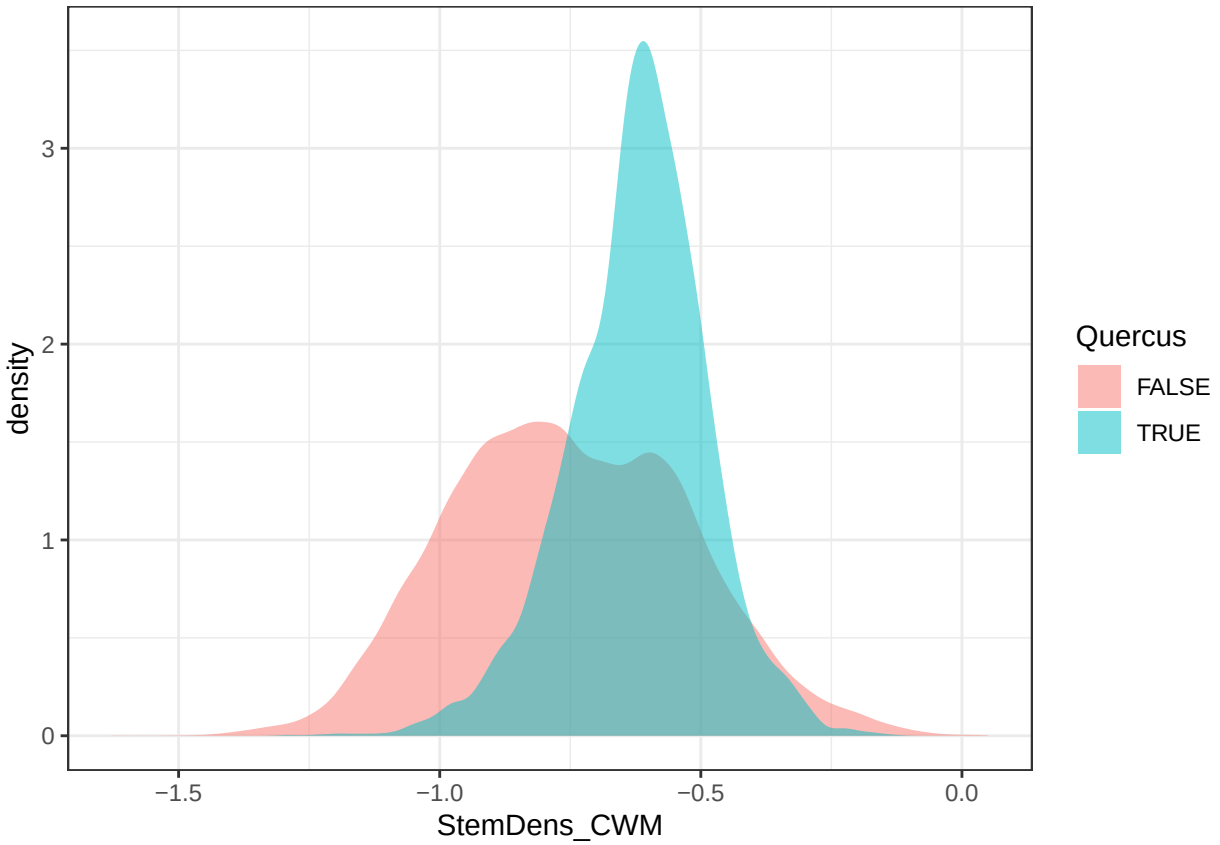
```
header.quercus %>%
  group_by(Biome) %>%
  summarize(n = n())
```

```
## # A tibble: 9 x 2
##   Biome                              n
## * <fct>                          <int>
## 1 Alpine                             6
## 2 Boreal zone                        7
## 3 Dry midlatitudes                  76
## 4 Dry tropics and subtropics       183
## 5 Subtropics with year-round rain 1157
## 6 Subtropics with winter rain      748
## 7 Temperate midlatitudes          1952
## 8 Tropics with summer rain         580
## 9 Tropics with year-round rain     434
```

Compare Community Weighted Means

Compare the distribution of the community weighted means of Stem density, between plots containing and not containing a *Quercus* species.

```
ggplot(data = CWM_CWV.quercus) +
  geom_density(aes(x = StemDens_CWM, fill = Quercus), col = NA, alpha = 0.5) +
  theme_bw()
```



Geographical distribution of plots containing a *Quercus* species

Download some spatial data of the world and create a template map using the r package `rnaturalearth`, first. Transform all geographical data to Eckert IV projection.

```
countries <- ne_countries(returnclass = "sf") %>%
  st_transform(crs = "+proj=eck4") %>%
  st_geometry()
graticules <- ne_download(type = "graticules_15", category = "physical",
                          returnclass = "sf") %>%
  st_transform(crs = "+proj=eck4") %>%
  st_geometry()
bb <- ne_download(type = "wgs84_bounding_box", category = "physical",
                  returnclass = "sf") %>%
  st_transform(crs = "+proj=eck4") %>%
  st_geometry()
```

Template of Global map - with country borders

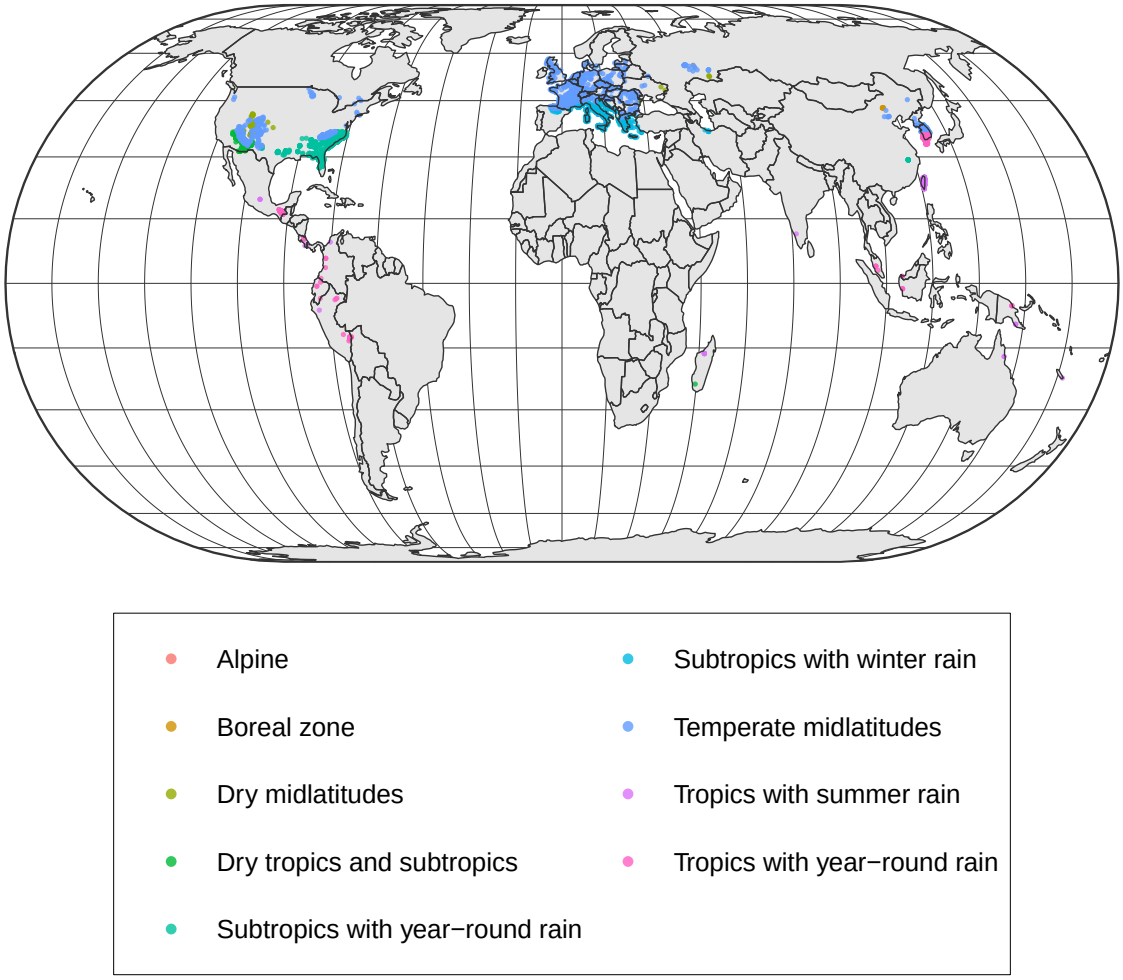
```
w3a <- ggplot() +
  geom_sf(data = bb, col = "grey20", fill = "white") +
  geom_sf(data = graticules, col = "grey20", lwd = 0.1) +
  geom_sf(data = countries, fill = "grey90", col = NA, lwd = 0.3) +
  coord_sf(crs = "+proj=eck4") +
  theme_minimal() +
  theme(axis.text = element_blank(),
        legend.title = element_text(size=12),
        legend.text = element_text(size=12),
        legend.background = element_rect(size = 0.1, linetype = "solid", colour = 1),
        legend.key.height = unit(1.1, "cm"),
        legend.key.width = unit(1.1, "cm"))
```

Project selected plots to Eckert IV and transform them to sf, before plotting.

```
header.quercus.sf <- SpatialPointsDataFrame(coords = header.quercus %>%
                                      dplyr::select(Longitude, Latitude),
                                    proj4string = CRS("+init=epsg:4326"),
                                    data=header.quercus %>%
                                      dplyr::select(-Longitude, -Latitude)) %>%
  st_as_sf() %>%
  st_transform(crs = "+proj=eck4")
```

Show all plots containing at least one *Quercus* species. Color code based on biomes.

```
(Figure1a <- w3a +
  geom_sf(data = header.quercus.sf, aes(color = Biome),
          pch = 16, size = 0.8, alpha = 0.8) +
  geom_sf(data = countries, col = "grey20", fill=NA, lwd = 0.3) +
  theme(legend.position = "bottom",
        legend.title = element_blank()) +
  guides(color = guide_legend(ncol = 2,
                              override.aes = list(size = 2))))
```


Alpine
Boreal zone
Dry midlatitudes
Dry tropics and subtropics
Subtropics with year−round rain
Subtropics with winter rain
Temperate midlatitudes
Tropics with summer rain
Tropics with year−round rain

Create a reference list for selected plots

Create reference list as BibText

```
sPlotOpen_citation(IDs=plotlist.quercus, level = "database",
                   out.file = "_output/demo.bib")
```

```
## Loading required package: bib2df
```

```
## Warning: package 'bib2df' was built under R version 4.0.3
```

```
## WARNING: This is a beta-version. References were parsed and converted automatically. They might need
```

```
# show first few lines of output file
read_lines("_output/demo.bib", n_max = 25)
```

```
##  [1] "@Article{dengler2012a,"
##  [2] "  Author = {Dengler, J{\\\"u}rgen and R{\\=u}si{\\c{n}}a, Solvita},"
##  [3] "  Editor = {Dengler, J. and Oldeland, J. and Jansen, F. and Chytr<fd>, M. and Ewald, J. and Fi
##  [4] "  Journal = {Biodiversity & Ecology},"
##  [5] "  Pages = {319<U+0096>320},"
##  [6] "  Title = {Database Dry Grasslands in the Nordic and Baltic region},"
##  [7] "  Volume = {4},"
##  [8] "  Year = {2012},"
##  [9] "  Doi = {10.7809/b-e.00114},"
## [10] "  Url = {https://doi.org/10.7809/b-e.00114},"
## [11] "  Language = {en}"
## [12] "}"
## [13] ""
## [14] ""
## [15] "@Article{biurrun2012a,"
## [16] "  Author = {Biurrun, Idoia and Garc{\\'\\i}a-Mijangos, Itziar and Campos, Juan A and Herrera, I
## [17] "  Editor = {Dengler, J. and Oldeland, J. and Jansen, F. and Chytr<fd>, M. and Ewald, J. and Fi
## [18] "  Journal = {Biodiversity & Ecology},"
## [19] "  Pages = {328},"
## [20] "  Title = {Vegetation-Plot Database of the University of the Basque Country (BIOVEG)},"
## [21] "  Volume = {4},"
## [22] "  Year = {2012},"
## [23] "  Doi = {10.7809/b-e.00121},"
## [24] "  Language = {en}"
## [25] "}"
```

Convert to reference list

```
mybib <- RefManageR::ReadBib("_output/demo.bib", check = FALSE)
```

```
## Loading required namespace: bibtex
```

```
mybib
```

```
## [1] E. Agrillo, N. Alessi, M. Massimi, et al. "Nationwide Vegetation
## Plot Database - Sapienza University of Rome: state of the art, basic
## figures and future perspectives". En. In: _Phytocoenologia_ 47 (2017),
## p. 221-229. DOI: 10.1127/phyto/2017/0139.
##
## [2] I. Apostolova, D. Sopotlieva, H. Pedashenko, et al. "Bulgarian
## Vegetation Database: historic background, current status and future
## prospects". En. In: _Biodiversity & Ecology_ 4 (2012). Ed. by J.
## Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald, M. Finckh and J.
```

Schaminée, p. 141-148. DOI: 10.7809/b-e.00069. <URL:
https://doi.org/10.7809/b-e.00069>.
##
[3] I. Aubin, S. Gachet, C. Messier, et al. "How resilient are northern
hardwood forests to human disturbance? An evaluation using a plant
functional group approach". En. In: _Ecoscience_ 14 (2007), p. 259-271.
<URL: https://www.jstor.org/stable/42901860>.
##
[4] I. Biurrun, I. García-Mijangos, J. A. Campos, et al.
"Vegetation-Plot Database of the University of the Basque Country
(BIOVEG)". En. In: _Biodiversity & Ecology_ 4 (2012). Ed. by J.
Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald, M. Finckh and J.
Schaminée, p. 328. DOI: 10.7809/b-e.00121.
##
[5] H. Bruelheide, M. Böhnke, S. Both, et al. "Community assembly
during secondary forest succession in a Chinese subtropical forest".
En. In: _Ecological Monographs_ 81 (2011), p. 25-41. DOI:
10.1890/09-2172.1.
##
[6] L. Casella, P. Bianco, P. Angelini, et al. "Italian National
Vegetation Database (BVN/ISPRA)". En. In: _Biodiversity & Ecology_ 4
(2012). Ed. by J. Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald,
M. Finckh and J. Schaminée, p. 404. DOI: 10.7809/b-e.00192. <URL:
https://doi.org/10.7809/b-e.00192>.
##
[7] L. Cayuela, L. Gálvez-Bravo, R. P. Pérez, et al. "The Tree
Biodiversity Network (BIOTREE-NET): prospects for biodiversity research
and conservation in the Neotropics". En. In: _Biodiversity & Ecology_ 4
(2012). Ed. by J. Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald,
M. Finckh and J. Schaminée, p. 211-224. DOI: 10.7809/b-e.00078. <URL:
https://doi.org/10.7809/b-e.00078>.
##
[8] T. Cerný, M. Kopecký, P. Petrík, et al. "Classification of Korean
forests: patterns along geographic and environmental gradients". En.
In: _Applied Vegetation Science_ 18 (2015), p. 5-22. DOI:
10.1111/avsc.12124.
##
[9] M. Chytrý and M. Rafajová. "Czech National Phytosociological
Database: basic statistics of the available vegetation-plot data". En.
In: _Preslia_ 75 (2003), p. 1-15.
##
[10] M. De Sanctis, G. Fanelli, A. Mullaj, et al. "Vegetation database
of Albania". Pt. In: _Phytocoenologia_ 47 (2017), p. 107-108. DOI:
10.1127/phyto/2017/0178.
##
[11] J. Dengler and S. R\=usi\cna. "Database Dry Grasslands in the
Nordic and Baltic region". En. In: _Biodiversity & Ecology_ 4 (2012).
Ed. by J. Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald, M.
Finckh and J. Schaminée, p. 319-320. DOI: 10.7809/b-e.00114. <URL:
https://doi.org/10.7809/b-e.00114>.
##
[12] P. Dimopoulos and I. Tsiripidis. "Hellenic Natura 2000 Vegetation
Database (HelNAtVeg)". En. In: _Biodiversity & Ecology_ 4 (2012). Ed.
by J. Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald, M. Finckh

and J. Schaminée, p. 388. DOI: 10.7809/b-e.00177. <URL:
https://doi.org/10.7809/b-e.00177>.
##
[13] J. Ewald, R. May, and M. Kleikamp. "VegetWeb - the national
online-repository of vegetation plots from Germany". En. In:
Biodiversity & Ecology 4 (2012). Ed. by J. Dengler, J. Oldeland, F.
Jansen, M. Chytrý, J. Ewald, M. Finckh and J. Schaminée, p. 173-175.
DOI: 10.7809/b-e.00073. <URL: https://doi.org/10.7809/b-e.00073>.
##
[14] E. Garbolino, P. De Ruffray, H. Brisse, et al. "The
phytosociological database SOPHY as the basis of plant socio-ecology
and phytoclimatology in France". En. In: _Biodiversity & Ecology_ 4
(2012), p. 177-184. DOI: 10.7809/b-e.00074.
##
[15] A. Indreica, P. Turtureanu, A. Szabó, et al. "Romanian Forest
Database: a phytosociological archive of woody vegetation". Pt. In:
Phytocoenologia 47 (2017), p. 389-393. DOI: 10.1127/phyto/2017/0201.
##
[16] U. Jandt and H. Bruelheide. "German Vegetation Reference Database
(GVRD)". En. In: _Biodiversity & Ecology_ 4 (2012). Ed. by J. Dengler,
J. Oldeland, F. Jansen, M. Chytrý, J. Ewald, M. Finckh and J.
Schaminée, p. 355. DOI: 10.7809/b-e.00146. <URL:
https://doi.org/10.7809/b-e.00146>.
##
[17] F. Jansen, J. Dengler, and C. Berg. "VegMV - the vegetation
database of Mecklenburg-Vorpommern". En. In: _Biodiversity & Ecology_ 4
(2012). Ed. by J. Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald,
M. Finckh and J. Schaminée, p. 149-160. DOI: 10.7809/b-e.00070. <URL:
https://doi.org/10.7809/b-e.00070>.
##
[18] Z. Kacki and M. Sliwinski. "The Polish Vegetation Database:
structure, resources and development". En. In: _Acta Societatis
Botanicorum Poloniae_ 81 (2012), p. 75-79. DOI: 10.5586/asbp.2012.014.
##
[19] A. Kuzemko. "Ukrainian Grasslands Database". En. In: _Biodiversity
& Ecology_ 4 (2012). Ed. by J. Dengler, J. Oldeland, F. Jansen, M.
Chytrý, J. Ewald, M. Finckh and J. Schaminée, p. 430. DOI:
10.7809/b-e.00217.
##
[20] K. Lájer, Z. Botta-Dukát, J. Csiky, et al. "Hungarian
Phytosociological database (COENODATREF): sampling methodology,
nomenclature and its actual stage". Pt. In: _Annali di Botanica, Nuova
Serie_ 7 (2008), p. 197-201.
##
[21] F. Landucci, A. Acosta, E. Agrillo, et al. "VegItaly: The Italian
collaborative project for a national vegetation database". En. In:
Plant Biosystems 146 (2012), p. 756-763. DOI:
10.1080/11263504.2012.740093.
##
[22] J. Lenoir, B. Graae, P. Aarrestad, et al. "Local temperatures
inferred from plant communities suggest strong spatial buffering of
climate warming across Northern Europe". En. In: _Global Change
Biology_ 19 (2013), p. 1470-1481. DOI: 10.1111/gcb.12129.
##

[23] H. Liu, H. Cui, R. Pott, et al. "Vegetation of the woodland-steppe
ecotone in southeastern Inner Mongolia, China". En. In: _Journal of
Vegetation Science_ 11 (2000), p. 525-532. DOI: 10.2307/3246582.
##
[24] T. Lysenko, O. Kalmykova, and A. Mitroshenkova. "Vegetation
Database of the Volga and the Ural Rivers Basins". En. In:
Biodiversity & Ecology 4 (2012). Ed. by J. Dengler, J. Oldeland, F.
Jansen, M. Chytrý, J. Ewald, M. Finckh and J. Schaminée, p. 420-421.
DOI: 10.7809/b-e.00208. <URL: https://doi.org/10.7809/b-e.00208>.
##
[25] R. K. Peet, M. T. Lee, M. D. Jennings, et al. "VegBank - a
permanent, open-access archive for vegetation-plot data". En. In:
Biodiversity and Ecology 4 (2012). Ed. by J. Dengler, J. Oldeland, F.
Jansen, M. Chytrý, J. Ewald, M. Finckh and J. Schaminée, p. 233-241.
DOI: 10.7809/b-e.00080. <URL: https://doi.org/10.7809/b-e.00080>.
##
[26] R. Peet, M. Lee, M. Boyle, et al. "Vegetation-plot database of the
Carolina Vegetation Survey". En. In: _Biodiversity & Ecology_ 4 (2012).
Ed. by J. Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald, M.
Finckh and J. Schaminée, p. 243-253. DOI: 10.7809/b-e.00081. <URL:
https://doi.org/10.7809/b-e.00081>.
##
[27] V. Prokhorov, T. Rogova, and M. Kozhevnikova. "Vegetation database
of Tatarstan". Pt. In: _Phytocoenologia_ 47 (2017), p. 309-313. DOI:
10.1127/phyto/2017/0172.
##
[28] S. Rusina. "Semi-natural Grassland Vegetation Database of Latvia".
En. In: _Biodiversity & Ecology_ 4 (2012). Ed. by J. Dengler, J.
Oldeland, F. Jansen, M. Chytrý, J. Ewald, M. Finckh and J. Schaminée,
p. 409. DOI: 10.7809/b-e.00197.
##
[29] J. Schaminée, J. Janssen, R. Haveman, et al. _Schatten voor de
natuur. Achtergronden, inventaris en toepassingen van de Landelijke
Vegetatie Databank_. Nl. Utrecht, The Netherlands: KNNV Uitgeverij,
2006.
##
[30] J. Šibík. "Slovak Vegetation Database". En. In: _Biodiversity &
Ecology_ 4 (2012). Ed. by J. Dengler, J. Oldeland, F. Jansen, M.
Chytrý, J. Ewald, M. Finckh and J. Schaminée, p. 429. DOI:
10.7809/b-e.00216.
##
[31] U. Šilc. "Vegetation Database of Slovenia". En. In: _Biodiversity
& Ecology_ 4 (2012). Ed. by J. Dengler, J. Oldeland, F. Jansen, M.
Chytrý, J. Ewald, M. Finckh and J. Schaminée, p. 428. DOI:
10.7809/b-e.00215.
##
[32] Z. Stancic. "Phytosociological Database of Non-Forest Vegetation
in Croatia". En. In: _Biodiversity & Ecology_ 4 (2012). Ed. by J.
Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald, M. Finckh and J.
Schaminée, p. 391. DOI: 10.7809/b-e.00180.
##
[33] K. Vassilev, H. Pedashenko, A. Alexandrova, et al. "Balkan
Vegetation Database: historical background, current status and future
perspectives". En. In: _Phytocoenologia_ 46 (2016), p. 89-95. DOI:

10.1127/phyto/2016/0109.
##
[34] K. Vassilev, Z. Stevanovic, R. Cušterevska, et al. "Balkan Dry
Grasslands Database". En. In: _Biodiversity & Ecology_ 4 (2012). Ed. by
J. Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald, M. Finckh and
J. Schaminée, p. 330-330. DOI: 10.7809/b-e.00123. <URL:
https://doi.org/10.7809/b-e.00123>.
##
[35] W. Willner, C. Berg, and P. Heiselmayer. "Austrian Vegetation
Database". En. In: _Biodiversity & Ecology_ 4 (2012). Ed. by J.
Dengler, J. Oldeland, F. Jansen, M. Chytrý, J. Ewald, M. Finckh and J.
Schaminée, p. 333. DOI: 10.7809/b-e.00125. <URL:
https://doi.org/10.7809/b-e.00125>.
##
[36] T. Wohlgemuth. "Swiss Forest Vegetation Database". En. In:
Biodiversity & Ecology 4 (2012). Ed. by J. Dengler, J. Oldeland, F.
Jansen, M. Chytrý, J. Ewald, M. Finckh and J. Schaminée, p. 340. DOI:
10.7809/b-e.00131.

sessionInfo()

```
sessionInfo()
```

```
## R version 4.0.1 (2020-06-06)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 19042)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United Kingdom.1252
## [2] LC_CTYPE=English_United Kingdom.1252
## [3] LC_MONETARY=English_United Kingdom.1252
## [4] LC_NUMERIC=C
## [5] LC_TIME=English_United Kingdom.1252
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] bib2df_1.1.1        RefManageR_1.3.0    rnaturalearth_0.1.0
##  [4] raster_3.4-5        sp_1.4-5            sf_0.9-7
##  [7] forcats_0.5.1       stringr_1.4.0       dplyr_1.0.4
## [10] purrr_0.3.4         readr_1.4.0         tidyr_1.1.2
## [13] tibble_3.0.6        ggplot2_3.3.3       tidyverse_1.3.0
##
## loaded via a namespace (and not attached):
##  [1] Rcpp_1.0.6         lubridate_1.7.9.2  lattice_0.20-41    class_7.3-18
##  [5] assertthat_0.2.1   digest_0.6.27      utf8_1.1.4         plyr_1.8.6
##  [9] R6_2.5.0           cellranger_1.1.0   backports_1.2.1    reprex_1.0.0
## [13] evaluate_0.14      e1071_1.7-4        highr_0.8          httr_1.4.2
## [17] pillar_1.5.0       rlang_0.4.10       readxl_1.3.1       rstudioapi_0.13
## [21] rmarkdown_2.7      labeling_0.4.2     rgdal_1.5-23       munsell_0.5.0
## [25] broom_0.7.5        compiler_4.0.1     modelr_0.1.8       xfun_0.21
```

```
## [29] pkgconfig_2.0.3    rgeos_0.5-5        htmltools_0.5.1.1  tidyselect_1.1.0
## [33] codetools_0.2-18   fansi_0.4.2        crayon_1.4.1       dbplyr_2.1.0
## [37] withr_2.4.1        humaniformat_0.6.0 grid_4.0.1         jsonlite_1.7.2
## [41] gtable_0.3.0       lifecycle_1.0.0    DBI_1.1.1          magrittr_2.0.1
## [45] units_0.7-0        scales_1.1.1       bibtex_0.4.2.3     KernSmooth_2.23-18
## [49] cli_2.3.0          stringi_1.5.3      farver_2.0.3       fs_1.5.0
## [53] xml2_1.3.2         ellipsis_0.3.1     generics_0.1.0     vctrs_0.3.6
## [57] tools_4.0.1        glue_1.4.2         hms_1.0.0          yaml_2.2.1
## [61] colorspace_2.0-0   classInt_0.4-3     rvest_0.3.6        knitr_1.31
## [65] haven_2.3.1
```