Package ‘letsR’

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Author  Bruno Vilela & Fabricio Villalobos
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Description  Handling, processing, and analyzing geographic
data on species’ distributions and environmental variables.
License  GPL-2
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letsR-package

Tools for Data Handling and Analysis in Macroecology.

Description

The letsR package is being developed to help researchers in the handling, processing, and analysis of macroecological data. Its purpose is to integrate these methodological processes into a single software platform for macroecological analyses. The package's main functions allow users to build presence-absence matrices, the basic analytical tool in macroecology, from species' geographical distributions and merge them with species' traits, conservation information (downloadable using functions from this package) and spatial environmental layers. In addition, other package's functions enable users to summarize and visualize information from presence-absence matrices.
Details

All functions in this package use a prefix and a suffix separated by a dot. The prefix refers to the package's name and the suffix to the actual function. This is done to avoid confusion with potentially similarly-named functions from other R packages. For instance, the letsR function used to create presence-absence matrices is called lets.presab (but see also lets.presab.birds and lets.presab.points) whereas the one used to add variables to a presence-absence matrix is called lets.addvar. The package's basic functions create and work on a particular S3 object class called PresenceAbsence. Such PresenceAbsence object class allows storing information beyond presence-absence data (e.g. user-defined grid-cell system) and using the generic plot, summary and print functions of R. Also, some package’s functions allow the user to input customary R objects (e.g. vector, matrix, data.frame).

Another set of functions in this package allow the user to download species’ information related to their description and conservation status as provided by the IUCN’s REdList database (lets.iucn, lets.iucn.ha, lets.iucn.his). For this, such functions use the IUCN’s RedList API to retrieve information from its webpage.

If you are looking for the most recent version of the package, you can get the development version of letsR on github (https://github.com/macroecology/letsR).

| Package: | lestR |
| Type: | Package |
| Version: | 3.1 |
| Date: | 2018-01-24 |
| License: | GPL-2 |

Author(s)

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References


IUCN

| IUCN | IUCN evaluation for frogs of Phyllomedusa genus |

Description

Result of the function lets.iucn applied to Southern American frog genera Phyllomedusa in 2014.

Usage

data(IUCN)
\textbf{lets.addpoly} \hspace{1cm} \textit{Add polygon coverage to a PresenceAbsence object}

\textbf{Description}

Add polygon coverage within cells of a PresenceAbsence object.

\textbf{Usage}

\texttt{lets.addpoly(x, y, z, onlyvar = FALSE)}

\textbf{Arguments}

- \texttt{x} \hspace{1cm} A \texttt{PresenceAbsence} object.
- \texttt{y} \hspace{1cm} Polygon of interest.
- \texttt{z} \hspace{1cm} A character indicating the column name of the polygon containing the attributes to be used.
- \texttt{onlyvar} \hspace{1cm} If TRUE only the matrix object will be returned.

\textbf{Value}

The result is a presence-absence matrix of species with the polygons’ attributes used added as columns at the right-end of the matrix. The Values represent the percentage of the cell covered by the polygon attribute used.

\textbf{Author(s)}

Bruno Vilela

\textbf{See Also}

\texttt{lets.presab.birds}
\texttt{lets.presab}
\texttt{lets.addvar}

\textbf{Examples}

```r
# Not run:
data(PAM)  # Phyllomedusa presence-absence matrix
require(maptools)
data(wrld_simpl)  # World map
Brazil <- wrld_simpl[wrld_simpl$NAME == "Brazil", ]  # Brazil (polygon)

# Check where is the variable name
# (in this case it is in "NAME" which will be my z value)
names(Brazil)
```
PAM_pol <- lets.addpoly(PAM, Brazil, "NAME")
## End(Not run)

### lets.addvar

*Add variables (in raster format) to a PresenceAbsence object*

**Description**

Add variables (in raster format), usually environmental, to a PresenceAbsence object. Variables are included as additional columns containing the aggregate/summarize value of the variable(s) in each cell of the presence-absence matrix.

**Usage**

`lets.addvar(x, y, onlyvar = FALSE, fun = mean)`

**Arguments**

- `x`: A *PresenceAbsence* object.
- `y`: Variables to be added in Raster or RasterStack format.
- `onlyvar`: If TRUE only the matrix object will be returned.
- `fun`: Function used to aggregate the variables(s) values over each cell. Note that this will only work for variables with a resolution value smaller (i.e. higher resolution) than the PAM.

**Value**

The result is a presence-absence matrix of species with the variables added as columns at the right-end of the matrix (but see the 'onlyvar' argument).

**Note**

The *PresenceAbsence* and the *Raster* variable must be in the same projection.

**Author(s)**

Bruno Vilela

**See Also**

- *lets.presab.birds*
- *lets.presab*
- *lets.addpoly*
Examples

```r
## Not run:
data(temp)  # Global mean temperature
data(PAM)   # Phyllomedusa presence-absence matrix
# Mean temperature
PAM_temp_mean <- lets.addvar(PAM, temp)
# Standard deviation of temperature
PAM_temp_sd <- lets.addvar(PAM, temp, fun = sd, onlyvar = TRUE)
# Mean and SD in the PAM
PAM_temp_mean_sd <- cbind(PAM_temp_mean, PAM_temp_sd)

## End(Not run)
```

### lets.classvar

*Frequency distribution of a variable within a species’ range*

**Description**

Based on a species Presence-Absence matrix including variables of interest (see `lets.addvar`), the function divides a continuous variable into classes and counts the frequency of each class within each species’ range.

**Usage**

```r
lets.classvar(x, groups = "default", pos, xy)
```

**Arguments**

- `x` Presence-absence matrix with a single variable added (see `lets.addvar`).
- `groups` The number of classes into which the variable will be divided. Default calculates the number of classes as the default for a histogram (`hist`).
- `pos` Column number containing the variable of interest.
- `xy` Logical, if TRUE the input matrix contains the geographic coordinates in the first two columns.

**Value**

A matrix with species in the rows and the variable’s classes in the columns.

**Author(s)**

Bruno Vilela

**References**

lets.correl

Examples

```r
## Not run:
data(PAM)
data(temp)
pamvar <- lets.addvar(PAM, temp)
resu <- lets.classvar(x = pamvar, pos = ncol(pamvar), xy = TRUE)
## End(Not run)
```

Description

Computes the Moran’s I correlogram of a single or multiple variables.

Usage

```r
lets.correl(x, y, z, equidistant = FALSE, plot = TRUE)
```

Arguments

- `x`: A single numeric variable in vector format or multiple variables in matrix format (as columns).
- `y`: A distance matrix of class `matrix` or `dist`.
- `z`: The number of distance classes to use in the correlogram.
- `equidistant`: Logical, if `TRUE` the classes will be equidistant. If `FALSE` the classes will have equal number of observations.
- `plot`: Logical, if `TRUE` the correlogram will be plotted.

Value

Returns a matrix with the Moran’s I Observed value, Confidence Interval (95 and Expected value. Also the p value of the randomization test, the mean distance between classes, and the number of observations. quase tudo

Author(s)

Bruno Vilela, Fabricio Villalobos, Lucas Jardim & Jose Alexandre Diniz-Filho

References

Examples

```r
## Not run:
data(PAM)
data(IUCN)

# Spatial autocorrelation in description year (species level)
midpoint <- lets.midpoint(PAM)
distan <- lets.distmat(midpoint[, 2:3])
moran <- lets.correl(IUCN$Description, distan, 12,
                     equidistant = FALSE,
                     plot = TRUE)

## End(Not run)
```

---

**lets.distmat**  
**Compute a geographic distance matrix**

**Description**

Calculates a geographic distance matrix based on a PresenceAbsence or a two column matrix of x(longitude) and y(latitude).

**Usage**

```r
lets.distmat(xy, asdist = TRUE, ...)
```

**Arguments**

- `xy` A PresenceAbsence object or a matrix with two columns (longitude, latitude).
- `asdist` Logical, if TRUE the result will be an object of class dist, if FALSE the result will be an object of class matrix.
- `...` Arguments to be passed to the function rdist.earth of package fields.

**Details**

This function basically facilitates the use of rdist.earth on a PresenceAbsence object, allowing also the user to have directly a dist object.

**Value**

The user can choose between dist and matrix class object to be returned. The resulting values are in kilometers (but see the argument `miles` in rdist.earth).

**Author(s)**

Bruno Vilela & Fabricio Villalobos
Examples

```r
## Not run:
data(PAM)
distPAM <- lets.distmat(PAM)
## End(Not run)
```

### lets.field

Create species’ values based on the species co-occurrence within focal ranges

#### Description

Create single species’ values based on the attributes of species co-occurring within individual ranges.

#### Usage

```r
lets.field(x, y, z, weight = TRUE, xy = NULL, count = FALSE)
```

#### Arguments

- `x`: A `PresenceAbsence` object or a presence-absence in matrix format (see `xy` argument for matrix use) with the species named in the columns.
- `y`: Species attribute to be considered. It must be a numeric attribute.
- `z`: Species names in the same order as the attributes and exactly the same as named in the matrix or in the `PresenceAbsence` object.
- `weight`: If `TRUE` the value is weighted by species’ range size, if `FALSE` the value is the mean of all species that co-occur within the focal species.
- `xy`: If `TRUE` the presence-absence matrix contains the cell coordinates in the first two columns.
- `count`: Logical, if `TRUE` a counting window will open.

#### Details

If the species do not co-occur with any other species `NaN` will be returned.

#### Author(s)

Bruno Vilela & Fabricio Villalobos
lets.gridirizer

Fits a grid into a PresenceAbsence object

Description

This function creates a grid in shapefile format and adds its cells' IDs to the presence-absence matrix. The function was created to facilitate the use of the PresenceAbsence object for the ones who prefer to work with a grid in shapefile format.

Usage

lets.gridirizer(x)

Arguments

x A PresenceAbsence object.

Value

The result is a list of two objects. The first is a grid in shapefile format; the second is a presence-absence matrix with an additional column called SP_ID (shapefile cell identifier).

Author(s)

Bruno Vilela
See Also

plot.PresenceAbsence
lets.presab.birds

Examples

## Not run:
data(PAM)
PAM.grid <- lets.gridirizer(PAM)
names(PAM.grid)
# Grid in polygon format (can be saved in shapefile)
PAM.grid$Grid
# Presence-absence matrix (begginig only)
head(PAM.grid$Presence[, 1:5])

## End(Not run)

lets.iucn

Download species’ information from the IUCN RedList online database (No longer supported)

Description

Get species’ information from the IUCN website([https://www.iucnredlist.org/](https://www.iucnredlist.org/)) for one or more species.

Usage

lets.iucn(input, count = FALSE)

Arguments

input Character vector with one or more species names, or an object of class PresenceAbsence.
count Logical, if TRUE a counting window will open.

Details

Note that you must be connected to the internet to use this function.

Value

Returns a data frame with the Species Name, Family, Conservation Status, Criteria used to establish the conservation status, Population Status, Year of Description (only for animals), and the Countries where it occurs. If species do not have information (i.e. have not been evaluated), the result is: NE (Not evaluated).
Author(s)
Bruno Vilela

See Also
lets.iucn.ha
lets.iucn.his

Examples

## Not run:
# Single species
lets.iucn("Pongo pygmaeus")

# Multiple species
sp <- c("Musonycteris harrisoni", "Ailuropoda melanoleuca", 
"Cebus flavius")
lets.iucn(sp)

## End(Not run)

lets.iucn.ha
Download species' habitat information from the IUCN RedList online database (No longer supported)

Description
Get species’ habitat information from the IUCN RedList website(https://www.iucnredlist.org/) for one or more species.

Usage
lets.iucn.ha(input, count = FALSE)

Arguments
input Character vector with one or more species names, or an object of the PresenceAbsence class.
count Logical, if TRUE a counting window will open.

Details
Note that you must be connected to the internet to use this function.

Value
A data frame with species names in the first column and the habitats where it occurs in the remaining columns, '1' if species is present in that habitat and '0' otherwise.
Author(s)
Bruno Vilela

See Also

tests.iucn

tests.iucn.his

Examples

```r
## Not run:
# Single species
tests.iucn.ha("Pongo pygmaeus")

# Multiple species
sp <- c("Musonycteris harrisoni", "Ailuropoda melanoleuca", "Cebus flavius")
tests.iucn.ha(sp)

## End(Not run)
```

Description

Get species conservation status over time (i.e. from 1980 to the present date available) from the IUCN website(https://www.iucnredlist.org/) for one or more species.

Usage

```r
tests.iucn.his(input, count = FALSE)
```

Arguments

- **input**: character vector with one or more species names, or an object of class `PresenceAbsence`.
- **count**: Logical, if TRUE a counting window will open.

Details

Note that you must be connected to the internet to use this function.
Value

A data frame with the species names in the first column rows and the years (1980 - present) in the remaining columns, the code represents the species’ conservation status (see the IUCN RedList website for details). If species do not have information (i.e. have not been evaluated), the result is: NE (Not evaluated).

Codes and categories:
- **EX**: Extinct
- **EW**: Extinct in the Wild
- **VU**: Vulnerable
- **EN**: Endangered
- **CR**: Critically Endangered
- **LC**: Least Concern
- **NT**: Near Threatened
- **DD**: Data Deficient
- **CT**: Commercially Threatened
- **IN**: Indeterminate
- **IK**: Insufficiently Known
- **LR**: Lower Risk
- **RA**: Rare

Author(s)

Bruno Vilela

See Also

- `lets.iucn.ha`
- `lets.iucn`

Examples

```r
## Not run:
# Single species
lets.iucn.his("Panthera onca")

# Multiple species
sp <- c("Rhincodon typus", "Ailuropoda melanoleuca")
lets.iucn.his(sp)

## End(Not run)
```
Description
Transform IUCN RedList conservation status to continuous values ranging from 0 to 5.

Usage
lets.iucncont(x, dd = NA, ne = NA)

Arguments
x A vector or a matrix containing IUCN codes to be transformed.
dd The value to be attributed to DD (data-deficient) species, the default option is NA.
ne The value to be attributed to NE (not-evaluated) species, the default option is NA.

Value
Returns a vector/matrix with continuous values from 0 to 5.
EX and EW = 5
CR = 4
EN = 3
VU = 2
NT = 1
LC = 0
DD = NA
NE = NA

Author(s)
Bruno Vilela

References

See Also
lets.iucn
Examples

```r
## Not run:
# Vector transformation
status <- sample(c("EN", "VU", "NT", "CR", "DD", "LC", "EX"), 30, replace = TRUE)
transV <- lets.iucncont(status)

# Matrix transformation
data(IUCN)
transM <- lets.iucncont(IUCN)

## End(Not run)
```

**lets.maplizer**

Create a matrix summarizing species’ attributes within cells of a PresenceAbsence object

**Description**

Summarize species attributes per cell in a presence-absence matrix.

**Usage**

```r
lets.maplizer(x, y, z, func = mean, ras = FALSE)
```

**Arguments**

- `x` A `PresenceAbsence` object.
- `y` Species attribute to be considered. It must be a numeric attribute.
- `z` Species names in the same order as the attributes and exactly the same as named in the `PresenceAbsence` object.
- `func` A function to summarize the species’ attribute in each cell (the function must return only one value).
- `ras` If TRUE the raster object will be returned together with the matrix.

**Value**

The result can be both a matrix or a list containing the following objects:

- **Matrix**: a matrix object with the cells’ geographic coordinates and the summarized species’ attributes within them.
- **Raster**: The summarized species’ attributes mapped in a raster object.

**Author(s)**

Bruno Vilela
lets.midpoint

See Also

lets.presab
lets.presab.birds

Examples

## Not run:
data(PAM)
data(IUCN)
trait <- IUCN$Description_Year
resu <- lets.maplizer(PAM, trait, PAM$S, ras = TRUE)
head(resu$Matrix)
plot(resu$Raster, xlab = "Longitude", ylab = "Latitude",
main = "Mean description year per site") ; map(add = TRUE)

## End(Not run)

lets.midpoint

*Compute the midpoint of species’ geographic ranges*

Description

Calculate species’ distributional midpoint from a presence-absence matrix using several methods.

Usage

```r
lets.midpoint(pam, planar = FALSE, method = "PC")
```

Arguments

- **pam**: A presence-absence matrix (sites in the rows and species in the columns, with the first two columns containing the longitudinal and latitudinal coordinates, respectively), or an object of class `PresenceAbsence`.
- **planar**: Logical, if FALSE the coordinates are in Longitude/Latitude. If TRUE the coordinates are planar.
- **method**: Default option, "PC" (polygon centroid) will generate a polygon from the raster, and calculate the centroid of this polygon. If planar = TRUE, the function centroid of the package geosphere is used. If planar = FALSE, the function gCentroid of the package rgeos is used. Note that for the "PC" method, users can only use PresenceAbsence objects. Note also that this method will not be the best for PresenceAbsence objects made from occurrence records, or that have multiple disjoint distributions. Users can also choose the geographic midpoint, using the option "GM". "GM" will create a bounding box across the extremes of the distribution and calculate the centroid. Alternatively, the midpoint can be calculated as the point that minimize the distance between all cells of the PAM,
using the method "CMD" (center of minimum distance). The user can also calculate the midpoint, based on the centroid of the minimum convex polygon of the distribution, using the method "MCC". This last method is useful when using a PresenceAbsence object made from occurrence records.

Value

A data.frame containing the species’ names and geographic coordinates (longitude [x], latitude [y]) of species’ midpoints.

Author(s)

Fabricio Villalobos & Bruno Vilela

See Also

lets.presab

lets.presab.birds

Examples

```r
## Not run:
data(PAM)
mid <- lets.midpoint(PAM, method = "PC")
mid2 <- lets.midpoint(PAM, method = "GM")
mid3 <- lets.midpoint(PAM, method = "CMD")
mid4 <- lets.midpoint(PAM, method = "MCC")
mid5 <- lets.midpoint(PAM, method = "PC", planar = TRUE)
mid6 <- lets.midpoint(PAM, method = "GM", planar = TRUE)
mid7 <- lets.midpoint(PAM, method = "CMD", planar = TRUE)
mid8 <- lets.midpoint(PAM, method = "MCC", planar = TRUE)

for (sp in 1:nrow(mid)) {
  #sp = 4 # Or choose a line or species
  plot(PAM, name = mid[sp, 1])
  points(mid[sp, -1], col = adjustcolor("blue", .8), pch = 20, cex = 1.5)
  points(mid2[sp, -1], col = adjustcolor("green", .8), pch = 20, cex = 1.5)
  points(mid3[sp, -1], col = adjustcolor("yellow", .8), pch = 20, cex = 1.5)
  points(mid4[sp, -1], col = adjustcolor("purple", .8), pch = 20, cex = 1.5)
  points(mid5[sp, -1], col = adjustcolor("orange", .8), pch = 20, cex = 1.5)
  points(mid6[sp, -1], col = adjustcolor("black", .8), pch = 20, cex = 1.5)
  points(mid7[sp, -1], col = adjustcolor("gray", .8), pch = 20, cex = 1.5)
  points(mid8[sp, -1], col = adjustcolor("brown", .8), pch = 20, cex = 1.5)
  Sys.sleep(1)
}
## End(Not run)
```
**lets.overlap**  
*Compute pairwise species' geographic overlaps*

**Description**

Creates a species geographic overlap matrix from a Presence-absence matrix.

**Usage**

```r
lets.overlap(pam, method = "Chesser&Zink", xy = NULL)
```

**Arguments**

- `pam`: A presence-absence matrix (sites in rows and species in columns, with the first two columns containing the longitudinal and latitudinal coordinates, respectively), or an object of class `PresenceAbsence`.
- `method`: The method used to calculate the overlap matrix. "Chesser&Zink" calculates the degree of overlap as the proportion of the smaller range that overlaps within the larger range (Chesser & Zink 1994). "Proportional" calculates the proportion of a range that overlaps another range, the resultant matrix is not symmetric. "Cells" will show the number of overlapping grid cells between a pair of species’ ranges (same for both species in a pair), here the resultant matrix is symmetric.
- `xy`: Logical, if `TRUE` the input matrix contains geographic coordinates in the first two columns.

**Author(s)**

Fabricio Villalobos & Bruno Vilela

**References**


**See Also**

- `lets.presab`
- `lets.presab.birds`
## Not run:
data(PAM)
CZ <- lets.overlap(PAM, method = "Chesser&Zink")
prop <- lets.overlap(PAM, method = "Proportional")
cells <- lets.overlap(PAM, method = "Cells")

## End(Not run)

---

**lets.pamcrop**

*Crop a PresenceAbsence object based on an input shapefile*

### Description

Crop a PresenceAbsence object based on a shapefile provided by the user.

### Usage

```r
lets.pamcrop(x, shp, remove.sp = TRUE)
```

### Arguments

- `x` A `PresenceAbsence` object.
- `shp` Object of class `SpatialPolygonsDataFrame` (see function `readShapePoly`) to crop the PresenceAbsence object.
- `remove.sp` Logical, if `TRUE` the final matrix will not contain species that do not match any cell in the grid.

### Value

The result is an object of class PresenceAbsence croped.

### Author(s)

Bruno Vilela

### See Also

- `plot.PresenceAbsence`
- `lets.presab.birds`
## Examples

```r
## Not run:
data(PAM)
# PAM before crop
plot(PAM, xlab = "Longitude", ylab = "Latitude",
     main = "Phyllomedusa species richness")

# Crop PAM to Brazil
require(maptools)
data(wrld_simpl) # World map
Brazil <- wrld_simpl[wrld_simpl$NAME == "Brazil", ] # Brazil (polygon)
PAM_crop <- lets.pamcrop(PAM, Brazil, remove.sp = TRUE)
plot(PAM_crop, xlab = "Longitude", ylab = "Latitude",
     main = "Phyllomedusa species richness (Brazil crop)",
     col = colorRampPalette(c("darkgreen", "yellow", "blue")))

## End(Not run)
```

---

### lets.presab

Create a presence-absence matrix of species' geographic ranges within a grid

### Description

Convert species' ranges (in shapefile format) into a presence-absence matrix based on a user-defined grid system

### Usage

```r
lets.presab(shapes,
             xmn = -180,
             xmx = 180,
             ymn = -90,
             ymx = 90,
             resol = 1,
             remove.cells = TRUE,
             remove.sp = TRUE,
             show.matrix = FALSE,
             crs = CRS("+proj=longlat +datum=WGS84"),
             crs.grid = crs,
             cover = 0,
             presence = NULL,
             origin = NULL,
             seasonal = NULL,
             count = FALSE)
```
Arguments

shapes Object of class SpatialPolygonsDataFrame (see function readShapePoly to open these files) containing the distribution of one or more species. Species names should be in a column (within the .DBF table of the shapefile) called BINOMIAL/binomial or SCINAME/sciname.

xmin Minimum longitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest)

xmax Maximum longitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest)

ymin Minimum latitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest)

ymax Maximum latitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest)

resol Numeric vector of length 1 or 2 to set the grid resolution.

remove.cells Logical, if TRUE the final matrix will not contain cells in the grid with a value of zero (i.e. sites with no species present).

remove.sp Logical, if TRUE the final matrix will not contain species that do not match any cell in the grid.

show.matrix Logical, if TRUE only the presence-absence matrix will be returned.

crs Character representing the PROJ.4 type description of a Coordinate Reference System (map projection) of the polygons.

crs.grid Character representing the PROJ.4 type description of a Coordinate Reference System (map projection) for the grid. Note that when you change this options you may probably change the extent coordinates and the resolution.

cover Percentage of the cell covered by the shapefile that will be considered for presence (values between 0 and 1).

presence A vector with the code numbers for the presence type to be considered in the process (for IUCN spatial data https://www.iucnredlist.org/resources/spatial-data-download, see metadata).

origin A vector with the code numbers for the origin type to be considered in the process (for IUCN spatial data).

seasonal A vector with the code numbers for the seasonal type to be considered in the process (for IUCN spatial data).

count Logical, if TRUE a counting window will open.

Details

The function creates the presence-absence matrix based on a raster object. Depending on the cell size, extension used and number of species it may require a lot of memory, and may take some time to process it. Thus, during the process, if count argument is set TRUE, a counting window will open so you can see the progress (i.e. in what polygon/shapefile the function is working). Note that the number of polygons is not the same as the number of species that you have (i.e. a species may have more than one polygon/shapefiles).
lets.presab.birds

Value

The result is a list object of class `PresenceAbsence` with the following objects:

**Presence-Absence Matrix**: A matrix of species’ presence(1) and absence(0) information. The first two columns contain the longitude (x) and latitude (y) of the cells’ centroid (from the gridded domain used);

**Richness Raster**: A raster containing species richness data;

**Species name**: A character vector with species’ names contained in the matrix.

*But see the optional argument `show.matrix`.

Author(s)

Bruno Vilela & Fabricio Villalobos

See Also

`plot.PresenceAbsence`

`lets.presab.birds`

`lets.shFilter`

Examples

```r
## Not run:
# Spatial distribution polygons of south american frogs
# of genus Phyllomedusa.
data(Phyllomedusa)
PAM <- lets.presab(Phyllomedusa, xmn = -93, xmx = -29,
                   ymn = -57, ymx = 15)
summary(PAM)
# Species richness map
plot(PAM, xlab = "Longitude", ylab = "Latitude",
     main = "Phyllomedusa species richness")
# Map of the specific species
plot(PAM, name = "Phyllomedusa nordestina")

## End(Not run)
```

lets.presab.birds *Create a presence-absence matrix of species’ geographic ranges within a grid for the Birdlife spatial data*

Description

Convert species’ ranges (in shapefile format and stored in particular folders) into a presence-absence matrix based on a user-defined grid. This function is specially designed to work with BirdLife Intl. shapefiles (http://www.birdlife.org).
Usage

```r
lets.presab.birds(
  path,
  xmn = -180,
  xmx = 180,
  ymn = -90,
  ymx = 90,
  resol = 1,
  remove.cells = TRUE,
  remove.sp = TRUE,
  show.matrix = FALSE,
  crs = NULL,
  crs.grid = crs,
  cover = 0,
  presence = NULL,
  origin = NULL,
  seasonal = NULL,
  count = FALSE
)
```

Arguments

- **path**: Path location of folders with one or more species’ individual shapefiles. Shapefiles with more than one species will not work on this function. To use multi-species shapefiles see `lets.presab`.

- **xmn**: Minimum longitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest).

- **xmx**: Maximum longitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest).

- **ymn**: Minimum latitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest).

- **ymx**: Maximum latitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest).

- **resol**: Numeric vector of length 1 or 2 to set the grid resolution.

- **remove.cells**: Logical, if TRUE the final matrix will not contain cells in the grid with a value of zero (i.e. sites with no species present).

- **remove.sp**: Logical, if TRUE the final matrix will not contain species that do not match any cell in the grid.

- **show.matrix**: Logical, if TRUE only the presence-absence matrix will be returned.

- **crs**: Character representing the PROJ.4 type description of a Coordinate Reference System (map projection) of the original polygons.

- **crs.grid**: Character representing the PROJ.4 type description of a Coordinate Reference System (map projection) for the grid. Note that when you change this options you may probably change the extent coordinates and the resolution.
cover  Porcentage of the cell covered by the shapefile that will be considered for presence (values between 0 and 1).
presence  A vector with the code numbers for the presence type to be considered in the process (for IUCN spatial data https://www.iucnredlist.org/resources/spatial-data-download, see metadata).
origin  A vector with the code numbers for the origin type to be considered in the process (for IUCN spatial data).
seasonal  A vector with the code numbers for the seasonal type to be considered in the process (for IUCN spatial data).
count  Logical, if TRUE a counting window will open.

Details

The function creates the presence-absence matrix based on a raster file. Depending on the cell size, extension used and number of species it may require a lot of memory, and may take some time to process it. Thus, during the process, if count argument is set TRUE, a counting window will open so you can see the progress (i.e. in what polygon the function is working). Note that the number of polygons is not the same as the number of species that you have (i.e. a species may have more than one polygon/shapefiles).

Value

The result is an object of class PresenceAbsence with the following objects:

Presence-Absence Matrix: A matrix of species’ presence(1) and absence(0) information. The first two columns contain the longitude (x) and latitude (y) of the cells’ centroid (from the gridded domain used);

Richness Raster: A raster containing species richness data;

Species name: A vector with species’ names contained in the matrix.

*But see the optional argument show.matrix.

Author(s)

Bruno Vilela & Fabricio Villalobos

See Also

plot.PresenceAbsence
lets.presab
lets.shFilter

Examples

## Not run:
# Constructing a Presence/Absence matrix for birds
# Attention: For your own files, omit the 'system.file'
# and 'package="letsR"', these are just to get the path
# to files installed with the package.
path.Ramphastos <- system.file("extdata", package = "letsR")
PAM <- lets.presab.birds(path.Ramphastos, xmn = -93, xmx = -29, ymn = -57, ymx = 25)

# Species richness map
plot(PAM, xlab = "Longitude", ylab = "Latitude",
     main = "Ramphastos species Richness")

## End(Not run)

lets.presab.grid

Create a presence-absence matrix of species’ geographic ranges within a user’s grid shapefile (beta version)

Description

Convert species’ ranges (in shapefile format) into a presence-absence matrix based on a grid in shapefile format.

Usage

lets.presab.grid(
    shapes,
    grid,
    sample.unit,
    remove.sp = TRUE,
    presence = NULL,
    origin = NULL,
    seasonal = NULL
)

Arguments

shapesObject of class SpatialPolygonsDataFrame (see function \texttt{readShapePoly} to open these files) containing the distribution of one or more species. Species names should be in a column (within the .DBF table of the shapefile) called BINOMIAL/binomial or SCINAME/sciname.

gridObject of class shapefile representing the spatial grid (e.g. regular/irregular cells, political divisions, hexagonal grids, etc). The grid and the shapefiles must be in the same projection.
sample.unitObject of class character with the name of the column (in the grid) representing the sample units of the presence absence matrix.

remove.spLogical, if \texttt{TRUE} the final matrix will not contain species that do not match any cell in the grid.
presence A vector with the code numbers for the presence type to be considered in the process (for IUCN spatial data [https://www.iucnredlist.org/resources/spatial-data-download](https://www.iucnredlist.org/resources/spatial-data-download), see metadata).

origin A vector with the code numbers for the origin type to be considered in the process (for IUCN spatial data).

seasonal A vector with the code numbers for the seasonal type to be considered in the process (for IUCN spatial data).

Details

This function is an alternative way to create a presence absence matrix when users already have their own grid.

Value

The result is a list containing two objects:

(I) A matrix the species presence (1) and absence (0) values per sample unity.

(II) The original grid.

Author(s)

Bruno Vilela & Fabricio Villalobos

See Also

plot.PresenceAbsence

lets.presab.birds

lets.shFilter

Examples

```r
## Not run:
# Grid
sp.r <- rasterToPolygons(raster(resol = 5))
slot(sp.r, "data") <- cbind("ID" = 1:length(sp.r),
                           slot(sp.r, "data"))

# Species polygons
data(Phyllomedusa)
projection(Phyllomedusa) <- projection(sp.r)

# PAM
resu <- lets.presab.grid(Phyllomedusa, sp.r, "ID")

# Plot
rich_plus1 <- rowSums(resu$PAM) + 1
colfunc <- colorRampPalette(c("#fff5f0", "#fb6a4a", "#67000d"))
colors <- c("white", colfunc(max(rich_plus1)))
plot(resu$grid, border = "gray40",
```
lets.presab.points

Create a presence-absence matrix based on species’ point occurrences

Description

Convert species’ occurrences into a presence-absence matrix based on a user-defined grid.

Usage

lets.presab.points(
  xy,
  species,
  xmn = -180,
  xmx = 180,
  ymn = -90,
  ymx = 90,
  resol = 1,
  remove.cells = TRUE,
  remove.sp = TRUE,
  show.matrix = FALSE,
  crs = CRS("+proj=longlat +datum=WGS84"),
  count = FALSE
)

Arguments

xy A matrix with geographic coordinates of species occurrences, first column is the longitude (or x), and the second latitude (or y).

species Character vector with species names, in the same order as the coordinates.

xmn Minimum longitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest)

xmx Maximum longitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest)

ymn Minimum latitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest)

ymx Maximum latitude used to construct the grid in which the matrix will be based (i.e. the [gridded] geographic domain of interest)

resol Numeric vector of length 1 or 2 to set the grid resolution.
remove.cells Logical, if TRUE the final matrix will not contain cells in the grid with a value of zero (i.e. sites with no species present).

remove.sp Logical, if TRUE the final matrix will not contain species that do not match any cell in the grid.

show.matrix Logical, if TRUE only the presence-absence matrix will be returned.

crs Character representing the PROJ.4 type description of a Coordinate Reference System (map projection) of the points.

count Logical, if TRUE a counting window will open.

Details

The function creates the presence-absence matrix based on a raster file. Depending on the cell size, extension used and number of species it may require a lot of memory, and may take some time to process it. Thus, during the process, if count argument is set TRUE, a counting window will open so you can see the progress (i.e. in what polygon the function is working). Note that the number of polygons is not the same as the number of species that you have (i.e. a species may have more than one polygon/shapeslges).

Value

The result is an object of class PresenceAbsence with the following objects:

Presence-Absence Matrix: A matrix of species’ presence(1) and absence(0) information. The first two columns contain the longitude (x) and latitude (y) of the cells’ centroid (from the gridded domain used);

Richness Raster: A raster containing species richness data;

Species name: A character vector with species’ names contained in the matrix.

*But see the optional argument show.matrix.*

Author(s)

Bruno Vilela & Fabricio Villalobos

See Also

plot.PresenceAbsence

lets.presab.birds

lets.presab

lets.shFilter

Examples

```r
# Not run:
species <- c(rep("sp1", 100), rep("sp2", 100),
rep("sp3", 100), rep("sp4", 100))
x <- runif(400, min = -69, max = -51)
y <- runif(400, min = -23, max = -4)
xy <- cbind(x, y)
```
```r
PAM <- lets.presab.points(xy, species, xmn = -93, xmx = -29,
                          ymn = -57, ymx = 15)
summary(PAM)
# Species richness map
plot(PAM, xlab = "Longitude", ylab = "Latitude",
     main = "Species richness map (simulated)")
# Map of the specific species
plot(PAM, name = "sp1")
## End(Not run)
```

### lets.rangesize

**Compute species' geographic range sizes**

This function calculates species’ range sizes from a PresenceAbsence object or directly from the species’ shapefiles.

#### Description

This function calculates species’ range sizes from a PresenceAbsence object or directly from the species’ shapefiles.

#### Usage

```r
lets.rangesize(
  x,                                
  species_name = x@data[, 1],       
  coordinates = "geographic",      
  units = "cell"
)
```

#### Arguments

- **x** A PresenceAbsence object or an SpatialPolygonsDataFrame.
- **species_name** Species names in the same order as in the SpatialPolygonsDataFrame (only needed if x is a SpatialPolygonsDataFrame).
- **coordinates** "geographical" or "planar". Indicate whether the shapefile has geographical or planar coordinates (only needed if x is a SpatialPolygonsDataFrame).
- **units** "cell" or "squaremeter". Indicate if the size units wanted are in number of cells occupied or in square meters (only needed if x is a PresenceAbsence object).

#### Value

The result is a matrix with the range size of each species. If the range size accounts for the earth curvature (Yes or No) or its size unit may differ for each argument combination:

1) SpatialPolygonsDataFrame & geographical = Square meters. Yes.
2) SpatialPolygonsDataFrame & planar = same units as the coordinates. No.
3) PresenceAbsence & cell = number of cells. No.
4) PresenceAbsence & squaremeter = Square meters. Yes.

Author(s)
Bruno Vilela

Examples

```r
## Not run:
# SpatialPolygonsDataFrame & geographical
data(Phyllomedusa)
rangesize <- lets.rangesize(x = Phyllomedusa,
coordinates = "geographic")

# SpatialPolygonsDataFrame & planar
rangesize2 <- lets.rangesize(x = Phyllomedusa,
coordinates = "planar")

# PresenceAbsence & cell
data(PAM)
rangesize3 <- lets.rangesize(x = PAM,
units = "cell")

# PresenceAbsence & squaremeter
rangesize4 <- lets.rangesize(x = PAM,
units = "squaremeter")

## End(Not run)
```

---

### lets.shFilter

Filter species' shapefiles based on its presence, origin, and season

#### Description

Filter species shapefiles by origin, presence, and seasonal type (following IUCN types: [https://www.iucnredlist.org/resources/spatial-data-download](https://www.iucnredlist.org/resources/spatial-data-download), see metadata).

#### Usage

```r
lets.shFilter(shapes, presence = NULL, origin = NULL, seasonal = NULL)
```

#### Arguments

- **shapes**: Object of class SpatialPolygonsDataFrame (see function [readShapePoly](https://example.com/readShapePoly) to open these files).
- **presence**: A vector with the code numbers for the presence type to be maintained.
lets.subsetPAM

origin A vector with the code numbers for the origin type to be maintained.
seasonal A vector with the code numbers for the seasonal type to be maintained.

Details
Origin codes: (1) Native, (2) Reintroduced, (3) Introduced, (4) Vagrant & (5) Origin Uncertain.
Seasonal codes: (1) Resident, (2) Breeding Season, (3) Non-breeding Season, (4) Passage & (5) Seasonal Occurrence Uncertain.
More info in the shapefiles’ metadata.

Value
The result is the shapefile(s) filtered according to the selected types. If the filters remove all polygons, the result will be NULL.

Author(s)
Bruno Vilela

See Also
plot.PresenceAbsence
lets.presab
lets.presab.birds

lets.subsetPAM Subset a PresenceAbsence object based on species names

Description
Subset a PresenceAbsence object based on species character vector provided by the user.

Usage
lets.subsetPAM(x, names, remove.cells = TRUE)

Arguments
x A PresenceAbsence object.
names Character vector with species names to subset the PresenceAbsence object.
remove.cells Logical, if TRUE the final matrix will not contain cells in the grid with a value of zero (i.e. sites with no species present).
**lets.summarizer**

**Summarize variable(s) values in a presence-absence matrix within species' ranges**

**Description**

Based on a Presence-Absence matrix with added variables (see *lets.addvar*), this function summarizes the values of such variable(s) per species (across the species’ occupied cells. i.e. within their ranges).

**Usage**

`lets.summarizer(x, pos, xy = TRUE, fun = mean)`

**Arguments**

- **x**: Presence-absence matrix with variables added.
- **pos**: Column position of the variables of interest.
- **xy**: Logical, if TRUE the input matrix contains geographic coordinates in the first two columns.
- **fun**: Function to be used to summarize the variable per species.
Author(s)
Bruno Vilela & Fabricio Villalobos

References

See Also
lets.addvar
lets.addpoly
lets.field

Examples
```r
## Not run:
data(PAM)
data(temp)
pamvar <- lets.addvar(PAM, temp)
resu <- lets.summarizer(x = pamvar, pos = ncol(pamvar),
                        xy = TRUE)
## End(Not run)
```

lets.transf Transform values of a vector

Description
Transform each element of a vector.

Usage
`lets.transf(x, y, z, NUMERIC = TRUE)`

Arguments

- `x` A vector to be transformed.
- `y` levels to be transformed.
- `z` The value to be attributed to each level (same order as y).
- `NUMERIC` logical, if TRUE z will be considered numbers.

Value
Return a vector with changed values.
Author(s)
Bruno Vilela

Examples
```
## Not run:
status <- sample(c("EN", "VU", "NT", "CR", "DD", "LC"), 30, replace=TRUE)
TE <- "Threatened"
NT <- "Non-Threatened"
new <- c(TE, TE, NT, TE, "Data Deficient", NT)
old <- c("EN", "VU", "NT", "CR", "DD", "LC")
statustrans <- lets.transf(status, old, new, NUMERIC=FALSE)

## End(Not run)
```

Description
PresenceAbsence object for frogs of Phyllomedusa genus

Usage
data(PAM)

Source

Phyllomedusa
Geographic distribution of Phyllomedusa genus

Description
Geographic distribution of the Southern American frog genera Phyllomedusa. Data was modified from IUCN (https://www.iucnredlist.org/, downloaded in 05/2014). There are 32 species and 46 polygons.

Usage
data(Phyllomedusa)

Source
**plot.PresenceAbsence**  
*Plot an object of class PresenceAbsence*

**Description**

Plots species richness map from an object of class PresenceAbsence or a particular species’ map.

**Usage**

```r
## S3 method for class 'PresenceAbsence'
plot(x, name = NULL, world = TRUE, col_rich = NULL, col_name = "red", ...)```

**Arguments**

- `x`: An object of class `PresenceAbsence`.
- `name`: A character specifying a species to be plotted instead of the complete species richness map.
- `world`: If `TRUE` a map of political divisions (countries) is added to the plot.
- `col_rich`: Color function (e.g. `rainbow`, `heat.colors`, `colorRampPalette`) to be used in the richness map.
- `col_name`: The color to use when plotting single species.
- `...`: Other parameters pass to the plot function.

**Author(s)**

Bruno Vilela

**See Also**

- `lets.presab`
- `lets.presab.birds`

**Examples**

```r
## Not run:
data(PAM)
plot(PAM)
plot(PAM, xlab = "Longitude", ylab = "Latitude", 
     main = "Phyllomedusa species richness")
plot(PAM, name = "Phyllomedusa atelopoides")
plot(PAM, name = "Phyllomedusa azurea")

## End(Not run)```
### PresenceAbsence Class

#### Description

The `PresenceAbsence` is a new S3 object class created and used inside the `letsR` package. This object class is used to store information on species distribution within a geographic domain in the form of a presence-absence matrix. In addition, the `PresenceAbsence` object also contains other essential information (e.g., user-defined grid cell system, including resolution, projection, datum, and extent) necessary for other analysis performed with the package’s functions.

#### Details

**Creating a PresenceAbsence object**

A `PresenceAbsence` object can be generated using the following functions:

- `lets.presab`
- `lets.presab.birds`
- `lets.presab.points`

**The PresenceAbsence information**

The result is a list object of class `PresenceAbsence` that includes the following objects:

- **Presence_and_Absence_Matrix**: A matrix of species’ presence(1) and absence(0) information. The first two columns contain the longitude (x) and latitude (y) of the cells’ centroid (from the gridded domain used);
- **Richness_Raster**: A raster containing species richness information across the geographic domain, which can be used to map the observed geographic gradient in species richness;
- **Species_name**: A character vector with species’ names contained in the matrix.

Each of the objects can be obtained using the standard subsetting operators that are commonly applied to a list object (i.e. ‘[]’ and ‘$’).

**letsR functions applied to a PresenceAbsence object**

The following functions from the `letsR` package can be directly applied to a `PresenceAbsence`:

- `lets.addpoly`
- `lets.addvar`
- `lets.distmat`
- `lets.field`
- `lets.gridirizer`
- `lets.iucn`
- `lets.iucn.ha`
- `lets.iucn.his`
- `lets.maplizer`
- `lets.midpoint`
- `lets.overlap`
Generic functions applied to a PresenceAbsence object
The following generic functions can be directly applied to the PresenceAbsence object.
- print (print.PresenceAbsence)
- summary (summary.PresenceAbsence)
- plot (plot.PresenceAbsence)
**Summary for object of class PresenceAbsence**

**Description**

Summary for objects of class PresenceAbsence.

**Usage**

```r
## S3 method for class 'PresenceAbsence'
summary(object, ...)
```

**Arguments**

- `object`: an object of class `PresenceAbsence`
- `...`: other summary parameters

**Author(s)**

Bruno Vilela

---

**temp**

*Average temperature raster for the world.*

**Description**

Average temperature raster in Celsius degrees (multiplied by 100) for the world in 10 arc min of resolution. Data was modified from WorldClim (http://worldclim.com/, downloaded in 05/2014).

**Usage**

```r
data(temp)
```

**Source**

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